Vector-Borne Diseases in California

2000 Annual Report

Vector-Borne Disease Section
California Department of Health Services

2000

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

DISEASE INVESTIGATIONS AND SURVEILLANCE BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CALIFORNIA DEPARTMENT OF HEALTH SERVICES

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ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

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A NOTE FROM THE CHIEF

I am pleased to submit to you the 2000 Annual Report for the Vector-Borne Disease Section of the California Department of Health Services. Our group of 24 scientists and support staff had a very active year, conducting prevention, surveillance, and control activities relative to existing and emerging vector-borne diseases in California. In August, human disease was associated for the first time with a rodent-borne arenavirus called Whitewater Arroyo. VBDS staff conducted field investigations of suspect and confirmed cases of arenavirus infection, and expanded rodent surveillance to understand the distribution of the virus in California. Eight cases of hantavirus pulmonary syndrome were identified, more than in any preceding year, providing additional incentive to expand our physician and public education efforts, often into regions of the state where human cases had not occurred previously.

Our research efforts included exploring the role of woodrats in the enzootic cycle of ehrlichiosis, conducting an epidemiological survey of human ehrlichiosis in Humboldt County, and initiating a longitudinal study of ecological factors associated with hantavirus in the Sierra Nevada. Education and training are always among our most important activities. Our staff gave 76 presentations, published 13 manuscripts, and sponsored all day workshops on vertebrate-borne diseases in conjunction with the Mosquito and Vector Control Association of California.

West Nile virus, a mosquito-borne disease agent first reported in the Western hemisphere in 1999, spread from 4 to 13 states in 2000. In response to the outbreak and rapid spread of this virus, California enhanced its existing mosquito-borne disease surveillance program to include detection of West Nile and other exotic viruses. The enhanced surveillance system successfully detected eastern equine encephalomyelitis virus in a Ventura County horse in May. Follow-up investigation indicated this case was likely associated with a vaccine received one week prior to onset of illness.

In April, the Director of DHS appointed nine individuals to serve on a Lyme Disease Advisory Committee (LDAC). This committee was established to advise DHS on strategies to enhance the awareness of the public and physicians about Lyme disease in California. Anne Kjemtrup, DVM, Ph.D., was hired to coordinate the activities and recommendations of the LDAC. Marco Metzger, Ph.D. and Mark Novak, Ph.D. also joined our staff in 2000, filling Public Health Biologist positions vacated by Wakoli Wekesa, Ph.D., in Ontario, and Bill Pitcher in Sacramento.

Many of you are our collaborators and colleagues, and I hope that you find the information contained in this annual report to be of value as we collectively strive to promote and protect the health of all Californians.

Respectfully,

Vicki Kramer, Ph.D.

Introduction

The mission of the Vector-Borne Disease Section (VBDS), California Department of Health Services (DHS) is to protect the health and well-being of Californians from insect and animal transmitted diseases and injurious pests. VBDS provides leadership, information, and consultation on vector-borne diseases to the general public and agencies engaged in vector control activities.

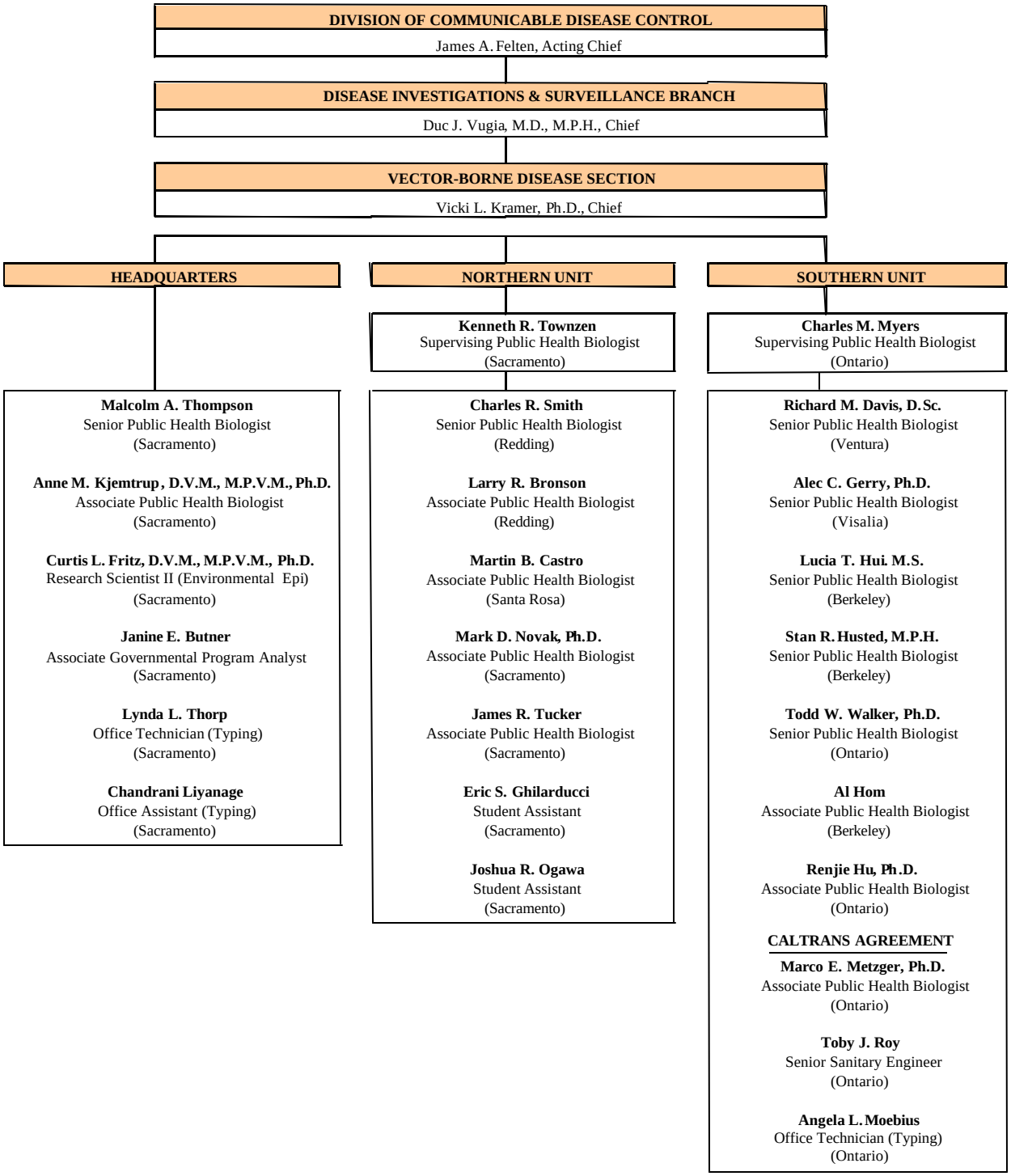
VBDS staff, located in seven regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease surveillance, prevention, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Oversee local vector control agency activities through a Cooperative Agreement
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies and the public
- Conduct emergency vector control when disease outbreaks occur
- Administer public health exemptions where applicable under the Endangered Species Act in disease outbreaks
- Advise local agencies on difficult public health issues related to vector-borne diseases
- Provide assistance in coordinating issues related to the management of the Africanized honey bee and red imported fire ant
- Advise local governmental agencies, schools, and the public on head lice management
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides

This report summarizes surveillance and control activities for plague, hantavirus pulmonary syndrome, and mosquito and tick-borne diseases in 2000. The VBDS head lice program is described. Activities conducted in the National Forests of California to protect United States Forest Service (USFS) personnel and visitors from vector-borne diseases are included in this report; USFS provides support for these activities through a cost-share agreement. Results from a special project with the California Department of Transportation to examine vector production in stormwater treatment devices are described. VBDS oversees the Vector Control Technician Certification Program; data summarizing the number of exams administered by VBDS and the number of vector control technicians in each certification category are provided. As education and training are important components of a vector-borne disease prevention program, a summary of the many presentations and reports originating from VBDS staff is included. Many of the state and local agencies with which VBDS collaborates are listed in the Acknowledgments section.

Authorizing statutes include: HSC 116108-116120; HSC 116102, et. seq.; HSC 116180; Gov. Code 12582

Personnel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Rodent-borne Virus Surveillance

Hantavirus pulmonary syndrome in California residents

Eight cases of hantavirus pulmonary syndrome (HPS) were identified in California residents during 2000. Investigations of these cases by the California Department of Health Services (DHS) and collaborating agencies are summarized below.

Mono County, March 2000. A 40-year-old female resident of Mono County presented at a local emergency clinic with a three-day history of fever, headache, chills, and muscle aches. The patient was hospitalized with compromised respiratory function. Thoracic radiographs obtained at admission revealed some interstitial infiltrates. Following hospitalization, the patient's respiratory function continued to deteriorate; she was intubated and transferred to University of California, Davis, Medical Center for intensive care the next day. The patient died later that evening. Antemortem serum collected at the local emergency clinic and sent to TriCore Laboratories, University of New Mexico, was reported positive for immunoglobulin M (IgM) and immunoglobulin G (IgG) to Sin Nombre virus (SNV). Testing of post-mortem serum by the Centers for Disease Control and Prevention (CDC) and DHS' Viral and Rickettsial Diseases Laboratory (VRDL) detected IgM and low IgG to SNV. Lung and kidney tissues were positive for hantavirus by immunohistochemistry conducted at CDC.

Interviews with the patient's family revealed no known rodent exposure and no history of travel during the putative exposure period. The case-patient lived in a mobile home in southern Mono County, approximately 100 meters from a local motel where she was employed as custodial staff. Staff of DHS' Vector-Borne Disease Section (VBDS) and the Environmental Health departments of Mono and Inyo Counties conducted site evaluations and rodent surveillance at the patient's residence, worksite, and surrounding areas. Inspection of the patient's residence revealed some evidence of rodent activity (droppings in cupboards and behind appliances) but no obvious infestation. Inspection of the motel and ancillary buildings revealed no evidence of rodent activity. Rodent trapping was attempted at the patient's residence, the motel and surrounding buildings, as well as in and around a nearby school. A total of 15 deer mice (*Peromyscus maniculatus*) were collected, of which five (33%) tested serologically positive for hantavirus. Information on rodent exclusion and control was provided to the patient's family, motel operator, and school administration.

Yolo County, April 2000. A 41-year-old male presented to a local hospital with four days of flu-like symptoms. At admission, the patient was noted to be febrile (105 °F) and thrombocytopenic (68,000/µL). The patient developed respiratory failure and died 24 hours after admission despite intubation and ventilatory support. Preliminary blood tests by a commercial laboratory suggested HPS; both IgM and IgG antibody to SNV were subsequently confirmed by VRDL.

The patient worked for a local trucking company and regularly hauled hay from stations in Yolo, Sacramento, and Colusa Counties to facilities (e.g., feed stores, racetracks) in Santa Cruz, Los Angeles, Imperial, and San Diego Counties. Interviews with the patient's family did not indicate other travel or recreational activities that could have placed him at risk of exposure to rodents. Staff of VBDS, Yolo County Environmental Health, and other local agencies investigated sites that the patient visited in the weeks preceding his illness. Visual inspections

of, and discussions with on-site personnel at, four delivery locations in southern California suggested that the patient would have had minimal to no opportunity for exposure to rodents as part of his job at these locations. Rodent surveillance was not performed at these sites. Site evaluations and rodent collection were conducted at pick-up and delivery facilities in northern California in Yolo (3 sites), Colusa, Sacramento, and Santa Cruz Counties. Trap success at all facilities was low (less than 10%) with house mice (*Musmusculus*) representing more than 50 percent of captures. Of 31 total deer mice (*P. maniculatus*) collected, only three of five from a pick-up site in Colusa County had serologic evidence of SNV infection. VBDS staff conducted a second round of rodent surveillance at the Colusa site in mid-June that yielded 11 deer mice; six of these, including four of four from an adjacent ranch, tested seropositive for SNV. In addition, one of three California voles (*Microtus californicus*) from the site was seropositive. However, these deer mice were collected from around rubbish piles and little-used buildings on the periphery of the facility, areas that the case-patient would not have visited as part of his normal job activities. Given the known itinerant history of the patient prior to onset of illness, as well as the inability to interview the patient regarding any other travels and activities during this period, the exact circumstances of exposure for this HPS case remain indeterminable.

Yolo County, May 2000. A 20-year-old male resident of Yolo County was hospitalized with "atypical pneumonia" following two days of fever, muscle ache, and cough. Although the patient developed respiratory compromise that required supplemental oxygen, he recovered completely and was discharged four days later. Serum collected at admission tested positive for IgM and IgG to SNV at a commercial laboratory; these results were subsequently confirmed at VRDL and CDC.

The patient reported having traveled to New Mexico in late March with a church group. The patient reported no other travel or activities that would pose a risk of rodent contact. While in New Mexico, the patient's church group worked on American Indian reservations where they performed maintenance and repair of buildings, including cleaning out reportedly rodent-infested sheds. All members of the group were provided masks to wear while working, but their actual use was reportedly infrequent. No other members of the group reported illness. This HPS case is noteworthy for the apparently protracted incubation period: approximately 46-51 days from exposure period to date of onset.

Ventura County, May 2000. A 27-year-old male resident of Ventura County was hospitalized with respiratory distress that required intubation and ventilatory support. Low grade fever (100.6 ^{o}F), thrombocytopenia (27,000/µL), and hemoconcentration (61%) were noted at admission. The patient survived. A commercial laboratory reported detecting IgM and IgG antibody to SNV; these results were subsequently confirmed by VRDL and CDC.

The patient lived in a multi-family residence in an urban part of the county. Evidence of *Rattus* sp. activity was evident in the garage; one night's trapping yielded no captures. He was employed as a groundskeeper for a commercial nursery since mid-April, but reported having seen no rodents on the property. Evidence of rodent activity was observed in some sheds where seed was stored. Rodent surveillance conducted by VBDS at the nursery and surrounding property yielded a total of 15 rodents, including five deer mice; all were seronegative for SNV. Because the patient was a poor historian and reticent to answer questions, it remains unclear what additional activities or travels may have contributed to his exposure.

Los Angeles County, June 2000. A 35-year-old male resident presented to a local hospital with a two-week history of gastrointestinal symptoms with shortness of breath for the last five days. Initial evaluation revealed fever, hemoconcentration, thrombocytopenia, and left-shift leukocytosis. Thoracic radiographs and CT scan revealed interstitial infiltrates and extensive pleural effusion. The patient responded to oxygen supplementation and did not require intubation or ventilatory support. He was discharged following ten days of hospitalization. VRDL, TriCore Laboratories, and CDC reported detecting IgG and IgM antibody to SNV in serum collected five days after admission.

The patient lived in the San Gabriel Valley and worked as a construction supervisor in southern California. Inspection of the patient's residence and worksite by the Los Angeles County Department of Health Services Vector Management Program identified minimal to no opportunity for contact with deer mice. The patient reported a fishing trip in early May to southern Mono County but denied seeing any evidence of rodents. Staff of VBDS and Mono County Environmental Health conducted evaluations and rodent surveillance at two facilities where the patient reported having stayed, one of which had reportedly been opened only recently prior to the case-patient's visit. While rodent harborage was prevalent around buildings, and significant populations of sciurid rodents were evident, no mice were trapped at either location.

Ventura County, August 2000. A 36-year-old male presented to a local hospital with a one-day history of fever. At admission, the patient was noted to have fever (103 °F), thrombocytopenia (67,000/µL), and leukocytosis (32,900/µL). Thoracic radiographs revealed interstitial infiltrates; the patient was intubated and provided mechanical ventilation. He eventually recovered and was discharged. A serum specimen collected shortly after admission was submitted to a commercial laboratory which detected low IgG and strong IgM reactivity to SNV. IgM antibody was detected in aliquots of this same specimen tested subsequently at VRDL, TriCore Laboratories, and CDC.

The patient resided in a developed area of Ventura County that provided minimal opportunity for contact with wild rodents. The patient reported camping in the eastern Sierra in early August, approximately one week prior to onset of illness. However, his activities consisted exclusively of hiking and sleeping outdoors, and he reported observing no mice. He brought his own food and camping equipment from home. Inspection of the storage facility in Ventura County where he kept the camping equipment revealed no evidence of rodents. No illness was reported in any other members of the camping party. The patient also reported visiting the Kaibab National Forest in northern Arizona in mid-July. Discussions with the staff of the United States Forest Service (USFS) indicated that while deer mice are present in the area, the lodgings at which the patient reported staying are well-maintained, regularly cleaned, and would pose little risk of exposure. Nevertheless, the lodge manager was notified of this case's possible association with the facility and USFS staff were reminded of the risk of hantavirus and the need to take appropriate precautions.

Los Angeles County, August 2000. A 52-year-old female resident was hospitalized with respiratory distress and thrombocytopenia following approximately four days of fever and fatigue. The patient's respiratory symptoms were relatively mild and she did not require intubation. Significant improvement was noted by day four of hospitalization and she was discharged on day ten. Serum was submitted to a commercial laboratory which reported

detecting IgM and IgG antibody to SNV. Subsequent testing of this same specimen by VRDL and CDC confirmed the presence of SNV IgM antibody.

The patient lived in the hills of western Los Angeles County. Inspection of her home by biologists from DHS and the Los Angeles County Department of Health Services revealed considerable potential harborage for rodents (e.g., outbuildings, abandoned vehicles) but thorough examination revealed no obvious signs of actual rodent activity within or around the home. The patient reported traveling by motor home to southwestern Utah two-to-three weeks prior to onset. (Onset of illness occurred one week after arrival home from the trip.) The patient rented a houseboat at Lake Powell, Utah, for approximately one week. While traveling to and from Lake Powell she stayed in the motor home, stopping for the evening at roadside RV parks. She reported that the houseboat was very clean, she did not observe any rodents, nor did she at any time during the trip enter any enclosed areas where rodents might have been present. Consultation by DHS with the Utah Department of Health indicated that while deer mice are prevalent in the Lake Powell area the houseboat concessionaires are well-informed about hantavirus and meticulous about cleanliness and rodent exclusion.

Sacramento County, September 2000. A 39-year-old female resident was hospitalized following five days of flu-like symptoms (fever, malaise, chills) and two days of cough and shortness of breath that progressed to adult respiratory distress syndrome (ARDS) and shock. Hematologic parameters at admission of thrombocytopenia (18,000/µL), leukopenia (600/µL), and slight hemoconcentration were suggestive of HPS. On the second day of hospitalization, the patient was transferred to a university hospital for extracorporeal membrane oxygenation (ECMO) therapy. The patient showed improved cardiopulmonary function and was removed from ECMO one week later. Serum specimens collected at admission and submitted to VRDL showed elevated IgM antibody to SNV. TriCore Laboratories confirmed both IgM and IgG seroreactivity to SNV.

The patient lived in a relatively new development in suburban Sacramento County. She reported seeing rodent droppings in an attic storage area and observed a single live mouse in the laundry room two days prior to onset. Upon inspection of the patient's residence by VBDS staff rodent droppings were identified in several areas, but were interpreted as most likely from house mice (*M. musculus*). No rodents were collected in or around the patient's residence over 180 trap-nights. Five *Microtus* sp. were collected from the surrounding neighborhood; sera from three (60%) of these tested positive for hantavirus antibody at VRDL. (These results most likely represent cross-reactivity to the hantavirus Isla Vista for which *Microtus* spp. are the principal reservoir.)

The patient reported camping in Yosemite National Park in late July. No other activities or travel were identified as possibly contributing to exposure. Staff of VBDS, the National Park Service (NPS), and Tuolumne County Department of Environmental Health conducted evaluation and rodent surveillance at the two sites in Yosemite National Park that the patient visited. Abundant evidence of rodent activity was observed at both sites. A total of 11 deer mice (*P. maniculatus*) were collected over 75 trap-nights at one site; of these, one (9%) was seropositive for SNV. At the other site, 89 deer mice were collected over 250 trap-nights, 21 (24%) of which were seropositive. Included were 13 seropositive deer mice from 32 (41%)

collected in and around the ranger headquarters. DHS recommended that NPS implement measures to decrease rodents in and around areas of human activity to reduce the risk of SNV transmission to park visitors and staff.

Since 1993, HPS has been diagnosed in 33 California residents (Tables 1 & 2). Four of these were identified retrospectively, with onset of illness having occurred in 1980, 1984, and 1992 (2). Fourteen cases had a fatal outcome. An additional two California residents have been diagnosed with acute SNV infection without pulmonary syndrome. The mean age of all 35 case-patients was 40 years (range, 17 to 68) and 16 were female. Case-patients were residents of 16 counties—Alameda, Contra Costa (2), Inyo (5), Kern (4), Los Angeles (2), Modoc, Mono (8), Nevada (2), Plumas, Sacramento, Santa Barbara, San Bernardino, San Francisco, Santa Clara, Ventura (2), and Yolo (2). Probable and possible sites of exposure included the counties of Alameda, Fresno, Inyo (5), Kern (4), Modoc, Mono (10), Nevada (2), Placer, Plumas, Santa Barbara, and Tuolumne, and the states of Arizona, New Mexico (3), Utah, and Washington.

Nationwide, CDC reported a total of 34 HPS cases in 2000. Since 1993, 282 HPS cases have been confirmed in residents of 31 states; of these, 39 cases were identified retrospectively with onset of illness prior to May 1993. California, Arizona, New Mexico, and Colorado account for over 45 percent of all U.S. HPS cases. One hundred eighty-six (61%) case-patients were male; 218 (77%) were white, 55 American Indian, five African-American, and three Asian; 32 were of Hispanic ethnicity. The mean age of case-patients was 37 years (range, 10 to 75). One hundred-six (38%) HPS cases had a fatal outcome; the case-fatality in HPS cases occurring since 1993 is 30 percent.

Hantavirus surveillance in California rodents

Surveillance for hantavirus in rodents was conducted in 22 California counties during 2000. A total of 1484 rodents were collected and serologically tested at the VRDL, representing at least 22 species from 11 genera (Table 3). At least one seroreactive rodent was detected in 14 counties; in three of these counties–Colusa, Sacramento, Yuba–rodents seroreactive to SNV were recorded for the first time in 2000. Of 1113 *Peromyscus* spp. collected, 68 (6.1%) had serologic evidence of infection with SNV. Seroprevalence was highest in *Peromyscus maniculatus* at 11.3 percent. Active surveillance since 1993 and retrospective analysis of rodent specimens captured since 1975 have identified serologic evidence of SNV infection in 537 (10.5%) of 5123 *P. maniculatus* tested. At least one seroreactive *P. maniculatus* specimen has been identified in 42 of 53 counties sampled (Table 4). *Reithrodontomys megalotis* and *Microtus californicus* specimens have demonstrated evidence of infection with Sin Nombre-like hantaviruses (El Moro Canyon and Isla Vista, respectively), but these strain variants have not been shown to be pathogenic to humans. Seroreactivity has been occasionally identified in *Neotoma*, *Chaetodipus*, and *Spermophilus* rodents in California and elsewhere; however, it is believed that these species are incidentally infected with SNV and are not competent reservoirs or vectors.

Arenaviruses

In August 2000, DHS reported on the deaths of three California residents, between June 1999 and June 2000, due to an arenavirus not previously recognized as a human pathogen. All three case-patients were female and were hospitalized with a febrile illness that progressed to respiratory and hepatic failure. The case-patients were a 52-year-old from Riverside County, a

14-year-old from Alameda County, and a 30-year-old from Orange County. Based on analysis conducted at the University of Texas Medical Branch, diagnosis of arenavirus infection was made by isolation of virus or recovery of viral genetic material by polymerase chain reaction (PCR) from one or more tissues. Upon further evaluation, arenavirus was ruled out as the cause of the Orange County patient's illness. Although DHS and local agencies continue their investigations into these cases, the source and circumstances of exposure remain unknown. The arenavirus associated with these cases was identified as Whitewater Arroyo (WWA), an arenavirus previously observed only in rodents, principally *Neotoma* spp. WWA was first identified in *Neotoma albigula* from New Mexico in the early 1990s. Subsequently, surveillance conducted by local agencies has documented evidence of WWA activity among rodent populations in several southern California counties. To date, no evidence of WWA has been observed in rodents collected north of the Tehachapi range.

Following recognition of these cases, DHS initiated a statewide surveillance program for arenaviruses, including providing clinical consultation for suspect cases of illness, facilitating appropriate diagnostic testing, and collecting and testing of resident rodent populations for evidence of infection.

Report prepared by Curtis Fritz

Table 1. California hantavirus pulmonary syndrome cases, 2000.

Case no.	Onset date	County of residence	Age	Sex	Outcome	Likely exposure locale	Exposure circumstances
26	March 2000	Mono	42	F	Died	Lee Vining, Mono	Peridomestic
27	May 2000	Yolo	41	M	Died	unknown	unknown
28	May 2000	Yolo	20	M	Surv	New Mexico	Occupational
29	May 2000	Ventura	27	M	Surv	unknown	unknown
30	June 2000	Los Angeles	35	M	Surv	Mono Co.	Recreational
31	August 2000	Ventura	36	M	Surv	Mono Co. or Arizona	Recreational
32	August 2000	Los Angeles	52	F	Surv	Utah	Recreational
33	September 2000	Sacramento	39	F	Surv	Tuolumne Co.	Recreational

Source: California Department of Health Services

Table 2. California hantavirus pulmonary syndrome cases, 1980-1999.

Case no.	Onset date	County of residence	Age	Sex	Outcome	Likely exposure locale	Exposure circumstances
1	February 1980	San Francisco	22	M	Died	New Mexico	Peridomestic
2	February 1984	Inyo	34	F	Died	Deep Springs, Inyo	Peridomestic
3	September 1992	Santa Barbara	29	M	Died	Solvang, Santa Barbara	Occupational
4	August 1992	Alameda	49	F	Died	Mono County or Washington	Recreational
5	July 1993	Mono	27	F	Died	Mammoth Lakes, Mono	Peridomestic
6	March 1994	San Bernardino	42	F	Surv	New Mexico	Peridomestic
7	May 1994	Kern	42	M	Died	Mojave, Kern	Occupational
8	September 1994	Mono	56	M	Surv	Lee Vining, Mono	Occupational
9	February 1995	Mono	42	F	Surv	Walker, Mono	Peridomestic
10	March 1995	Nevada	47	M	Surv	Truckee, Nevada	Occupational
11	June 1995	Mono	45	M	Died	Crowley Lake, Mono	Peridomestic
12	August 1995	Contra Costa	55	M	Died	Cisco Grove, Placer	Recreational
13	September 1995	Plumas	32	F	Surv	Graeagle, Plumas	Peridomestic
14	July 1996	Modoc	49	M	Surv	Alturas, Modoc	Peridomestic
15	July 1997	Nevada	43	M	Surv	Truckee, Nevada	Recreational
16	October 1997	Inyo	38	M	Surv	Bishop, Inyo	Occupational
non-P 1	July 1998	Mono	37	F	Surv	Mono Co.	Peridomestic
17	August 1998	Mono	55	F	Surv	Mono Co.	Occupational
18	August 1998	Santa Clara	19	F	Surv	Hume Lake, Fresno	Occupational
19	November 1998	Kern	68	M	Died	Inyokern, Kern	Peridomestic
20	March 1999	Kern	33	M	Surv	Taft, Kern	Occupational
21	April 1999	Kern	23	M	Died	Shafter, Kern	Peridomestic
22	June 1999	Inyo	17	F	Died	Bishop, Inyo	Peridomestic
23	June 1999	Inyo	66	F	Surv	Olancha, Inyo	unknown
24	July 1999	Mono	47	F	Surv	Swall Meadows, Mono	Peridomestic
non-P 2	September 1999	Inyo	50	M	Surv	Independence, Inyo	Recreational?
25	April 1999	Contra Costa	27	F	Died	Contra Costa or Alameda	unknown

Non-P # = Acute Sin Nombre virus infection without pulmonary syndrome

Source: California Department of Health Services

Table 3. Serologic evidence of hantavirus in rodents collected in California, 1975-2000.

Species	Common name	2000 No. collected	2000 No. reactive	2000 Percent	1975-2000 No. collected	1975-2000 No. reactive	1975-2000 Percent
FAMILY SIGMODONTIDAE (New World mice and rats)							
Neotoma fuscipes	dusky-footed woodrat	71	0		600	4	0.7
Neotoma lepida	desert woodrat	52	2	3.8	279	6	2.2
Neotoma sp.	other and non-speciated *Neotoma*	10	0		60	2	3.3
Onychomys torridus	southern grasshopper mouse	0			1	0	
Peromyscus boylii	brush mouse	210	10	4.8	715	20	2.8
Peromyscus californicus	parasitic mouse	306	4	1.3	945	23	2.4
Peromyscus crinitus	canyon mouse	30	1	3.3	95	4	4.2
Peromyscus eremicus	cactus mouse	75	0		396	7	1.8
Peromyscus maniculatus	deer mouse	462	52	11.3	5123	537	10.5
Peromyscus truei	piñon mouse	26	1	3.8	544	19	3.5
Peromyscus sp.	other and non-speciated *Peromyscus*	4	0		104	12	11.5
Reithrodontomys megalotis[1]	western harvest mouse	64	8	12.5	387	49	12.7
Sigmodon hispidus	hispid cotton rat	8	0		22	0	
FAMILY ARVICOLIDAE (voles)							
Clethrionomys californicus	California red-backed vole	0			1	0	
Microtus californicus[2]	California vole	14	5	35.7	133	25	18.8
Microtus spp.[2]	other and non-speciated *Microtus*	12	3	25.0	24	4	16.7
FAMILY HETEROMYIDAE							
Chaetodipus spp.	pocket mice	65	1	1.5	203	2	1.0
Dipodomys spp.	kangaroo rat	1	0		68	1	1.5
Perognathus parvus	Great Basin pocket mouse	3	0		26	1	3.8
FAMILY SCIURIDAE (squirrels and chipmunks)							
Ammospermophilus leucurus	white-tailed antelope squirrel	1	0		5	0	
Glaucomys sabrinus	northern flying squirrel	0			1	0	
Sciurus griseus	western gray squirrel	0			1	0	
Spermophilus spp.	ground squirrels	0			1226	1	0.1
Tamias spp.	chipmunks	0			284	0	
Tamiasciurus douglasii	Douglas's squirrel	0			8	0	
FAMILY MURIDAE (Old World mice and rats)							
Mus musculus	house mouse	60	0		230	0	
Rattus spp.	Norway rat & black rat	10	0		157	0	

[1]El Moro Canyon virus
[2]Isla Vista virus

Source: California Department of Health Services

Table 4. Serologic evidence of hantavirus in *Peromyscus maniculatus* collected in California, 1975-2000*.

	2000			1975-2000		
County	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Alameda	3	0		47	2	4.3
Alpine				55	11	20.0
Butte				115	14	12.2
Calaveras				45	9	20.0
Colusa	23	9	39.1	23	9	39.1
Contra Costa				36	0	
Del Norte				49	1	2.0
El Dorado				41	6	14.6
Fresno				462	59	12.8
Glenn				4	0	
Humboldt				55	5	9.1
Imperial				6	1	16.7
Inyo				75	5	6.7
Kern	10	1	10.0	129	10	7.8
Lake				22	1	4.5
Lassen	15	2	13.3	41	5	12.2
Los Angeles	10	0		334	16	4.8
Madera				62	8	12.9
Marin				105	3	2.9
Mendocino				16	0	
Merced				68	4	5.9
Modoc				65	10	15.4
Mono	15	5	33.3	227	47	20.7
Monterey	52	4	7.7	106	9	8.5
Mariposa				46	7	15.2
Napa				24	0	
Nevada	11	0		150	52	34.7
Orange				204	10	4.9
Placer	3	0		32	2	6.2
Plumas				67	14	20.9
Riverside	37	0		490	22	4.5
Sacramento				36	0	
San Bernardino	31	2	6.5	245	8	3.3
San Diego	70	5	7.1	289	15	5.2
San Francisco				30	0	
San Joaquin				11	1	9.1
San Luis Obispo				65	5	7.7
San Mateo	15	2	13.3	113	6	5.3
Santa Barbara	1	0		301	86	28.6
Santa Clara	7	0		32	0	
Shasta				32	4	12.5
Sierra				46	9	19.6
Siskiyou				117	12	10.3
Solano				3	0	
Sonoma				133	1	0.8
Stanislaus				15	0	
Tehama				35	5	14.3
Trinity				24	8	33.3
Tulare				20	2	10.0
Tuolumne	100	22	22.0	130	23	17.7
Ventura	5	0		190	10	5.3
Yolo	23	0		24	0	
Yuba	31	0		31	0	
Total	**462**	**52**	**11.3**	**5123**	**537**	**10.5**

*These data represent records currently entered in the DHS statewide rodent hantavirus database and are not necessarily comprehensive of results of all hantavirus surveillance conducted by local departments, academic researchers, and other agencies which conduct regional surveillance independent of DHS. Counties for which DHS has yet to document results of rodent hantavirus surveillance are not listed.

Source: California Department of Health Services

Plague Surveillance and Control

This report presents data collected through the California Department of Health Services (DHS) Cooperative Plague Surveillance Program. In cooperation with local, state, and federal agencies, DHS collects and collates information on suspect and confirmed plague activity among humans, domestic pets, and wild animals throughout California.

Human Cases

One case of plague was identified among human residents of California in 2000.

In July, a 61-year-old male resident of Kern County presented to a Bakersfield hospital with fever (105 °F), chills, difficulty breathing, and prostration. An enlarged inguinal lymph node was noted at admission. Thoracic radiographs revealed slight pleural effusion and possible pulmonary infiltrate. Blood cultures collected at admission grew organisms identified as *Yersinia pestis* at a local laboratory; these cultures were confirmed as *Y. pestis* by the DHS Microbial Diseases Laboratory. The patient was placed in respiratory isolation and was treated with tetracycline. He recovered and was later released.

This case appeared to be in the early stages of secondary plague pneumonia at the time of hospital admission. Several persons who had contact with the patient were notified, but only his wife was adjudged to have had sufficient exposure to warrant antibiotic prophylaxis.

The patient resided on a ranch in Caliente, west of Tehachapi, where he worked with domestic animals. Investigation by the DHS Vector-Borne Disease Section (VBDS) indicated an abundant ground squirrel population at the site. Several ground squirrel burrows were noted to be abandoned, suggesting a partial die-off in the population. Additional evidence of an epizootic was found at a nearby development where property owners had reported several dead squirrels. Fleas collected from squirrels trapped at both locations tested negative for *Y. pestis*. One ground squirrel from the Caliente location, however, was serologically positive for plague; the antibody titer of 1:4096 suggested recent infection.

The Kern County Health Department issued a press release to inform area residents of the plague case and provide them precautionary information about plague in infected animals and fleas. The owner of the ranch in Caliente dusted squirrel burrows to reduce flea numbers near areas of human activity.

Domestic Pets

Seven domestic cats, two feral cats, and one domestic dog with clinical signs suggestive of plague had specimens submitted to DHS for testing. Laboratory testing failed to confirm plague in any of these animals.

Wild Animals

Blood samples from 614 wild carnivores were collected from 33 counties and tested for plague through a cooperative surveillance program with the United States Department of Agriculture, Animal and Plant Health Inspection Service's Wildlife Services and other collaborators. Of these blood specimens, 49 tested positive for antibody to *Y. pestis* (Table 5). Coyotes accounted

for 32 (65%) of the 49 carnivore positive specimens. Sero-positive wild carnivores and feral pigs were identified in 19 California counties: El Dorado, Fresno, Kern, Lassen, Los Angeles, Mendocino, Modoc, Nevada, Plumas, San Bernardino, San Diego, San Luis Obispo, Santa Clara, Shasta, Sierra, Siskiyou, Tulare, Tuolumne, and Yuba.

Bacteriological and serological sampling of wild rodents for plague was conducted in 21 California counties through the DHS cooperative program. Serological sampling was conducted in two additional counties, Los Angeles and Orange, with testing provided through local laboratories. Sero-positive California ground squirrels were found in six of the 23 counties: Kern, Inyo, Nevada, Riverside, San Bernardino, and Ventura. Three lodgepole pine chipmunks and one golden-mantled ground squirrel were found positive in Mono County. Sero-positive yellow-pine chipmunks, pine squirrels, and California ground squirrels were detected at a recreational site near Truckee, Nevada County. Sero-positive woodrats, a chipmunk, and a deer mouse were found at a site in the Los Padres National Forest in Ventura County. Plague epizootics, confirmed by observation of rodent die-off and bacteriological testing of rodents and rodent fleas, were detected in Kern (see human case investigation) and Nevada Counties. Plague-positive fleas were recovered from rodents trapped as part of the investigation of the epizootic in Nevada County.

As a result of positive findings, plague control was conducted at recreational sites in Los Angeles, Inyo, Nevada, and Riverside Counties. Flea control was conducted through application of 2% diazinon insecticide dust in burrow dusting and bait stations. At the campground near Truckee, Nevada County, liquid deltamethrin applied to modified carpet-lined bait stations was utilized to control fleas on California ground squirrels.

Report prepared by Charles Smith, Al Hom, Malcolm Thompson, and Curtis Fritz

Table 5. Plague positive mammals in California (All specimens are serum [Nobuto], except where otherwise indicated).

County Location[1]	No. Specimens Tested	Positive	Positive species	Result	Month
Alameda	40	0			
Alpine	1	0			
Butte	2	0			
Colusa	1	0			
Contra Costa	12	0			
El Dorado	58	4			
El Dorado, 4S			Raccoon	1:64	July
Placerville, 5N			Black bear	1:256	August
Shingle Springs, 5S			Coyote	1:256	September
So. Lake Tahoe			Coyote	1:512	August
Fresno	36	1			
Shaw & West 33 Hwy			Coyote	1:32	July
Inyo	42	1			
Inyo NF, Four Jeffrey CG			CA G Sq	1:256	July
Kern	92	6			
Bodfish			Black bear	1:512	October
Frazier Park			Coyote	1:18192	May
Lebec			Coyote	1:2048	July
Loraine			CA G Sq	1:4096	July
Los Padres NF, McGill CG			CA G Sq	1:512	August
Twin Oaks, 15SE			Black bear	1:2048	July
Lassen	7	5			
Doyle, 1E			Coyote	1:128	February
Doyle, 5S			Coyote	1:128	February
Madeline, 10W			Coyote	1:512	July
Madeline, 12E			Coyote	1:1024	August
Wendle, 3E			Coyote	1:128	February
Los Angeles[2]	15	8			
Altadena			Coyote	1:512	May
Altadena			Coyote	1:2048	May
Angeles NF, Chilao CG			Black bear	1:128	July
Angeles NF, Chilao CG			Black bear	1:512	July
Crystal Lake			Black bear	1:2048	June
Crystal Lake			Black bear	1:512	August
Crystal Lake			Black bear	1:16384	August
Crystal Lake			Black bear	1:32	August
Mariposa	18	0			
Mendocino	50	1			
Longvale, 2W			Feral pig	1:512	July
Modoc	35	5			
Alturas, 8E			Coyote	1:512	April
Eagleville			Coyote	1:64	April
Eagleville, 3S			Coyote	1:128	July
Eagleville, 8S			Coyote	1:256	March
Jess Valley			Coyote	1:2048	August
Mono	21	4			
Inyo NF, Shady Rest CG			Chipmunk, LP	1:2048	July
Inyo NF, Shady Rest CG			Chipmunk, LP	1:2048	July
Inyo NF, Shady Rest CG			Chipmunk, LP	1:512	July
Inyo NF, Shady Rest CG			GM G Sq	1:2048	July

Table 5. Plague positive mammals in California (All specimens are serum [Nobuto], except where otherwise indicated). Continued.

County Location[1]	No. Specimens Tested	No. Specimens Positive	Positive species	Result	Month
Monterey	83	0			
Nevada	61	14			
Alpine Meadows CG			Chipmunk, YP	POS[3]	July
Alpine Meadows CG			CA G Sq	POS[4]	August
Alpine Meadows CG			CA G Sq	1:512	August
Alpine Meadows CG			CA G Sq	1:64	August
Alpine Meadows CG			Chipmunk, YP	1:1024	August
Alpine Meadows CG			Chipmunk, YP	1:2048	August
Alpine Meadows CG			Chipmunk, YP	1:2048	August
Alpine Meadows CG			Chipmunk, YP	1:32	August
Alpine Meadows CG			Chipmunk, YP	1:4096	August
Alpine Meadows CG			Chipmunk, YP	1:512	August
Alpine Meadows CG			Pine squirrel	1:16	August
Alpine Meadows CG			Pine squirrel	1:256	August
Alpine Meadows CG			Pine squirrel	1:64	August
Nevada City, 10N			Black bear	1:1024	August
Orange	2	0			
Placer	26	0			
Plumas	23	2			
Beckwourth, 3E			Coyote	1:64	January
Beckwourth, 3N			Coyote	1:32	February
Riverside	177	8			
Mt San Jacinto SP, Stone Creek CG			CA G Sq	1:512	July
San Bernardino NF, Boulder Basin CG			CA G Sq	1:1024	June
San Bernardino NF, Marion Mountain CG			CA G Sq	1:1024	July
San Bernardino NF, Marion Mountain CG			CA G Sq	1:64	July
San Bernardino NF, Marion Mountain CG			CA G Sq	1:128	August
San Bernardino NF, Marion Mountain CG			CA G Sq	1:256	August
San Bernardino NF, Marion Mountain CG			CA G Sq	1:512	August
San Bernardino NF, Marion Mountain CG			CA G Sq	1:8192	September
San Benito	18	0			
San Bernardino	196	3			
Big Bear Lake			Coyote	1:1024	May
Big Bear Lake			Coyote	1:16384	May
Upland			CA G Sq	1:32	August
San Diego	70	1			
Chula Vista			Coyote	1:64	April
San Luis Obispo	50	2			
Paso Robles			Feral pig	1:128	October
San Luis Obispo			Mountain lion	1:512	March
San Mateo	17	0			
Santa Barbara	26	0			
Santa Clara	93	3			
Cupertino			Coyote	1:256	March
Cupertino			Coyote	1:512	March
Los Altos			Coyote	1:512	March
Shasta	22	3			
Hat Creek, 4E			Coyote	1:1024	February
Hat Creek, 4E			Coyote	1:64	February
Hat Creek, 4E			Coyote	1:256	March

Table 5. Plague positive mammals in California (All specimens are serum [Nobuto], except where otherwise indicated). Continued.

County Location[1]	No. Specimens Tested	Positive	Positive species	Result	Month
Sierra	19	2			
Loyalton, 2N			Coyote	1:32	January
Sierra Valley			Coyote	1:4096	August
Siskiyou	15	2			
Dorris, 17SE			Coyote	1:64	February
Macdoel, 18E			Badger	1:64	February
Sonoma	7	0			
Tulare	2	1			
Johnsondale			Black bear	1:256	July
Tuolumne	8	1			
Yosemite NP, Tuolumne Meadows CG			Black bear	1:512	August
Ventura	121	5			
Los Padres NF, Chuchupate CG			CA G Sq	1:512	October
Los Padres NF, Chuchupate CG			Chipmunk, M	1:1024	October
Los Padres NF, Chuchupate CG			Deer mouse	1:1256	October
Los Padres NF, Chuchupate CG			Woodrat, DF	1:512	June
Los Padres NF, Chuchupate CG			Woodrat, DF	1:256	June
Yolo	1	0			
Yuba	33	1			
Beale AFB			Coyote	1:512	October

[1] Mileage and direction from nearest town may be indicated
[2] Plague surveillance and test results submitted by Los Angeles County Department of Health Services
[3] Carcass
[4] Fleapool

Abbreviations:

Location: AFB, Air Force Base
NF, National Forest
NP, National Park
CG, Campground
SP, State Park

Species: CA G Squirrel, California ground squirrel
GM G Squirrel, Golden-mantled ground squirrel
Chipmunk LP, Lodgepole chipmunk
Chipmunk M, Merriam's chipmunk
Chipmunk YP, Yellow-pine chipmunk
Woodrat DF, Dusky-footed woodrat

Result: POS, *Y. pestis* recovered by culture
1:n, positive antibody titer by passive or indirect hemmagglutination test

Source: California Department of Health Services

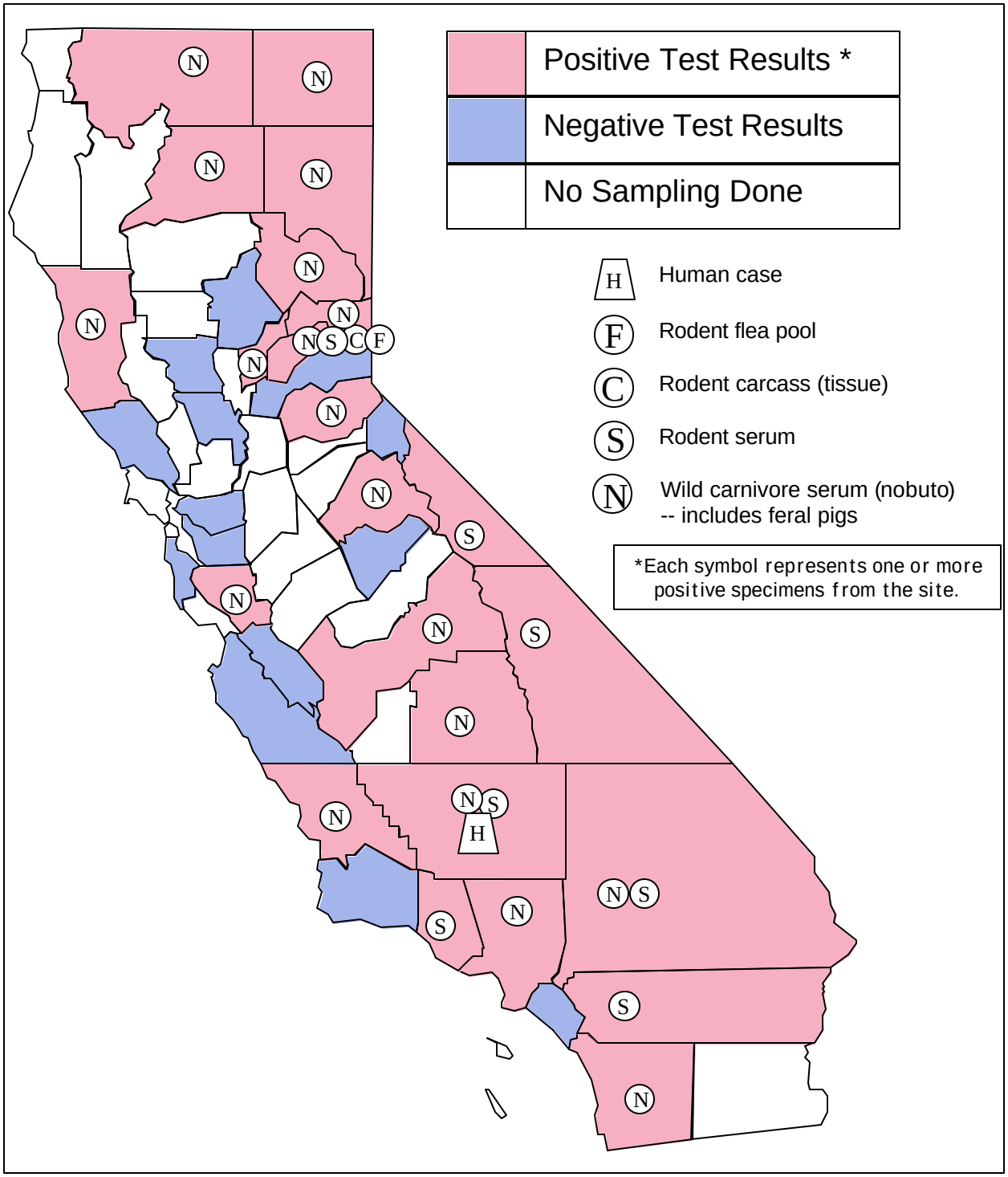

Figure 1. Distribution of plague-positive specimens by county, 2000.

Source: California Department of Health Services

Tick-borne Disease Surveillance

Lyme disease

A total of 95 cases of Lyme disease were reported to the California Department of Health Services (DHS) in 2000 (Figure 2). The median age of reported cases was 40 years (range, 4 to 82 years) and 52 (55%) were female. Of 90 cases for which race was reported, 81 (90%) were white.

Case-patients were residents of 32 counties (Table 6). Humboldt and San Diego counties reported the most cases (10 each), followed by Nevada (9) and Sonoma (8). Population-adjusted incidence was highest in Nevada County at 9.3 cases reported per 100,000 residents (Figure 3). Of 87 case-patients for whom county of likely exposure was reported, 36 (41%) were likely exposed outside their county of residence; 19 (22%) of these reported exposure outside California. Counties in which exposure was most frequently reported were Sonoma (10 cases), Humboldt (9), Nevada (8), and Mendocino (7).

Erythema migrans (EM) was diagnosed in 54 (57%) reported Lyme disease cases. Of 51 EM cases for whom a date of onset was reported, 30 (59%) occurred between May and August. Thirty (59%) Lyme disease patients with EM reported a recognized tick bite prior to onset of their illness.

The Vector-Borne Disease Section (VBDS) maintains a statewide database of ticks collected and tested for *Borrelia burgdorferi* infection. *Borrelia burgdorferi* surveillance in ticks serves to increase public awareness of Lyme disease throughout California as well as identify specific areas where public education on tick-borne disease may need to be emphasized. In 2000, a total of 2,015 adult and 14 nymphal *Ixodes pacificus* (the tick vector of *B. burgdorferi* in California) from 11 counties were tested by seven different laboratories. These laboratories used four different techniques—direct fluorescent antibody, indirect fluorescent antibody, culture, or polymerase chain reaction (PCR)—which vary in their specificity for *B. burgdorferi*. Positive results were reported for ticks collected from five California counties (Table 7). Positive ticks were collected from one site each in Alameda, Del Norte, Nevada, and Tulare Counties, and three sites in Los Angeles County.

Following legislation that acknowledged the need for enhanced Lyme disease education, the Director of DHS appointed a nine-member committee to provide advice to DHS on its Lyme disease education program. Members represent the California Medical Association (1), local health departments (1), academia (2), the general public (4), and DHS (1). The mission of the committee is "to make recommendations to the Department of Health Services on strategies to enhance the awareness of the public and medical community about Lyme disease in California, and thereby reduce exposure to, and suffering from, this disease."

Babesiosis

In May 2000, a five-week-old premature male infant hospitalized in Alameda County developed signs of babesiosis. Parasitized erythrocytes were observed seven days after the onset of symptoms. Serology and DNA sequencing confirmed that the infant was infected with the WA-1 type *Babesia*. The infant had received blood transfusions nine and 21 days previously from the

father and an anonymous donor, respectively. Neither parent was the source of infection as evaluated by blood smear examination, serology, PCR, and hamster inoculation. Serology and hamster inoculation of blood collected from the donor two months after the implicated donation confirmed the donor as the source of infection. The DNA sequences of protozoans isolated from the infant and donor were 100% identical. The infant recovered following appropriate treatment.

The donor was a resident of Alameda County whose only reported travel was to a family ranch in central Oregon in December 1999. The donor recalled no tick bite. Significant clinical history consisted of a self-reported 10-day period of slight nausea in April 2000. Though asymptomatic, the donor was advised to initiate appropriate treatment to prevent persistent parasitemia.

This infant represents the fifth case of clinical illness due to infection with *Babesia* sp. WA-1 identified in California; the most recent previous case occurred in a resident of Mono County in 1994. This case also represents the second known instance of *Babesia* sp. WA-1 transmission through transfusion of blood products.

Rocky Mountain spotted fever

Serum specimens from 42 suspect cases of Rocky Mountain spotted fever were submitted to the DHS Viral & Rickettsial Disease Laboratory (VRDL) for testing in 2000. One case was confirmed.

A male resident of San Bernardino County reported onset of fever, neck swelling, muscle aches, and headache in April. VRDL detected serum IgM (>1:80) and IgG (1:256) to *Rickettsia rickettsii*. The patient claimed to have "continuous exposure to ticks" as part of his work in wooded areas of the San Bernardino Mountains. The patient also reported travel to Kern County. VBDS continues its follow-up investigation of this case.

Ehrlichiosis

Serum specimens from 51 suspect ehrlichiosis patients were submitted to VRDL for testing in 2000. No case was confirmed.

In collaboration with U. S. Army Center for Health Promotion & Preventive Medicine –West (USCHPPM-W), a total of 550 adult *I. pacificus* and 45 adult *Dermacentor occidentalis* collected from 18 sites in Alameda, Monterey, Riverside, and San Luis Obispo Counties were tested for infection with *Ehrlichia chaffeensis* and *Ehrlichia equi*. All ticks were negative by nested PCR.

Tick-borne relapsing fever

Seven cases of tick-borne relapsing fever were reported in 2000. Case-patients were residents of six counties: San Francisco (2), Mariposa, Mono, Monterey, Nevada, and Santa Clara. Counties of likely exposure were Mono (2), Nevada, Placer (2), and Tulare; exposure site was not recorded for one case. Onsets of illness occurred in June, August (3), September (2), and October.

The Mariposa and Santa Clara relapsing fever case-patients were employees of the U.S. National Park Service stationed in Yosemite National Park. Both had onset of illness in August. Staff of VBDS conducted an investigation of the ranger station where both case-patients lived and

worked. Residential and work buildings were located in an ecotonal habitat that supported significant populations of squirrels, chipmunks, and other rodents. These buildings were observed to be aged structures with numerous sites of potential ingress for rodents. Recommendations were provided to the National Park Service on building maintenance and rodent exclusion options to help reduce the risk for relapsing fever transmission.

Staff of VBDS and the Placer County Department of Health conducted an investigation of a cabin near Lake Tahoe which was associated with the two San Francisco cases. The cabin was of recent construction, but evidence of rodent ingress was noted by a hole chewed in the wall next to the master bedroom. Sealing of this hole by the owners and exclusion of the rodent (probably a chipmunk) from its nest had likely led to the ticks searching out an alternative host upon which to feed. Five *Ornithodoros hermsi* ticks were collected from the residence; these were submitted to Rocky Mountain Laboratories for spirochete culture and characterization. Recommendations for on-going rodent control were provided to the owners of the cabin.

Report prepared by Curtis Fritz, Lucia Hui, Anne Kjemtrup, and Malcolm Thompson

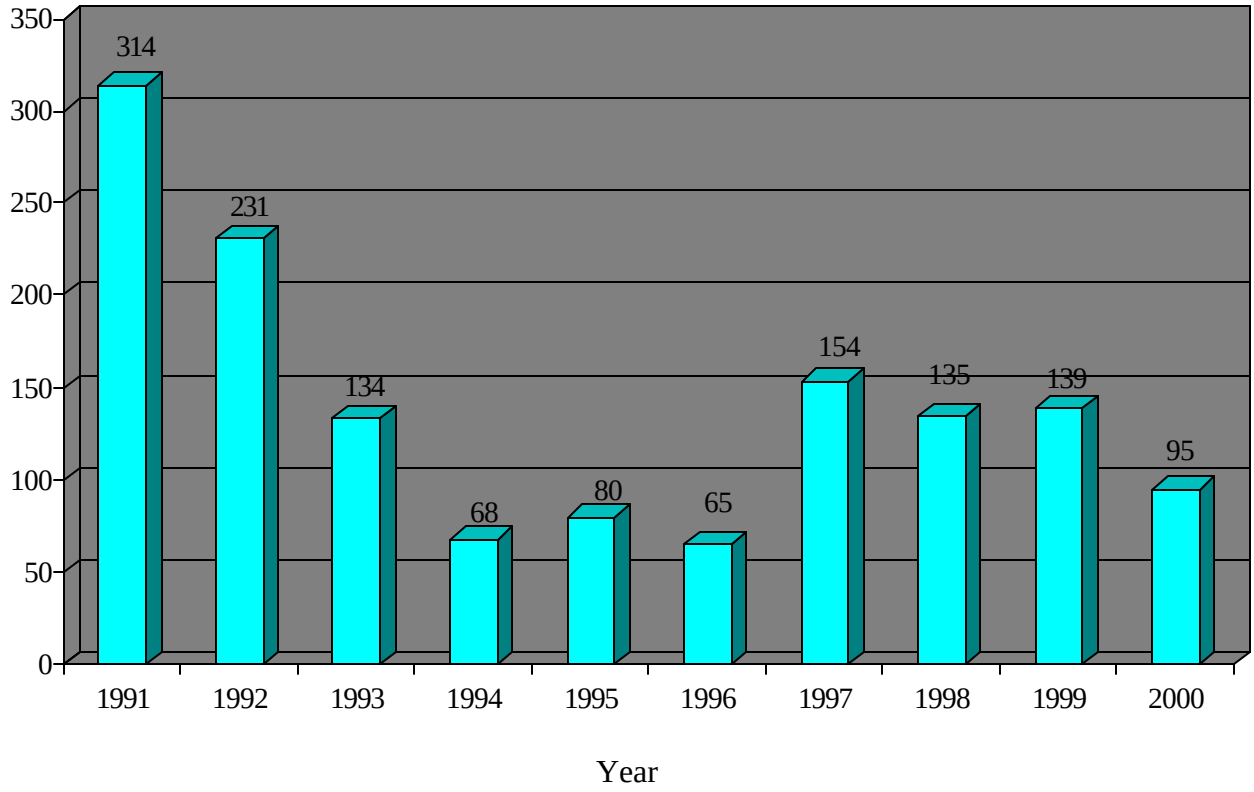

Figure 2. Cases of Lyme disease reported in California, 1991-2000.

Source: California Department of Health Services

Table 6. Cases of Lyme disease reported in California, 1991-2000.

County	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Incidence per 100,000 p-ys
Alameda	7	4	7	1	2	2	3	6	3	5	0.31
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	0	0	0	0	0	0	1	0	0.33
Butte	4	0	3	0	1	4	53	13	18	3	5.44
Calaveras	0	1	0	0	0	0	0	0	0	1	0.63
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	5	2	4	2	0	1	6	2	1	1	0.30
Del Norte	0	0	3	0	2	0	1	0	1	0	2.98
El Dorado	1	0	0	2	4	0	3	2	1	0	1.19
Fresno	5	2	3	0	0	1	0	0	0	1	0.19
Glenn	0	5	0	0	0	0	2	0	1	1	3.63
Humboldt	31	17	6	2	4	5	19	20	14	10	10.66
Imperial	0	0	0	0	0	0	1	0	0	0	0.09
Inyo	0	0	0	0	0	0	0	0	0	0	0.00
Kern	3	4	2	2	1	1	2	2	2	2	0.39
Kings	1	0	0	0	0	0	0	0	0	0	0.10
Lake	7	7	6	1	2	0	1	2	1	0	5.33
Lassen	1	0	0	0	0	0	2	1	2	0	2.17
Los Angeles	7	9	3	2	5	2	6	3	7	1	0.05
Madera	1	0	1	0	0	0	0	0	1	0	0.34
Marin	5	6	4	2	10	0	4	8	4	3	2.00
Mariposa	0	1	0	0	0	0	0	0	0	0	0.70
Mendocino	34	32	23	4	12	3	2	16	8	7	17.67
Merced	1	0	0	0	0	0	2	0	1	1	0.28
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	1	1	0	0	1	1	0	0	1	0	5.02
Monterey	2	0	4	1	2	0	2	1	2	1	0.45
Napa	1	1	2	0	0	1	3	0	2	2	1.08
Nevada	0	4	5	8	0	2	1	4	5	9	4.84
Orange	6	6	3	0	0	0	0	1	2	3	0.09
Placer	8	2	2	2	1	0	5	4	2	1	1.56
Plumas	1	1	0	0	1	3	0	2	1	0	3.55
Riverside	8	4	3	2	0	1	0	0	0	3	0.18
Sacramento	6	0	1	0	1	0	5	1	1	3	0.17
San Benito	0	0	0	0	0	0	0	0	0	0	0.00
San Bernardino	10	7	1	3	1	0	0	0	1	1	0.17
San Diego	2	5	4	7	6	5	4	0	16	10	0.24
San Francisco	1	2	2	1	1	4	1	7	1	0	0.30
San Joaquin	2	0	1	2	0	1	2	0	0	0	0.17
San Luis Obispo	2	2	1	1	0	1	0	1	1	1	0.46
San Mateo	3	4	3	2	1	2	3	4	4	2	0.43
Santa Barbara	7	2	1	0	3	1	1	3	0	0	0.54
Santa Clara	3	6	2	3	2	2	4	6	2	2	0.21
Santa Cruz	3	4	5	2	3	2	2	2	2	5	1.31
Shasta	3	6	0	3	1	1	0	2	0	0	1.09
Sierra	0	0	0	0	0	0	0	0	0	0	0.00
Siskiyou	5	0	2	1	0	0	1	1	0	0	2.30
Solano	0	2	0	0	0	0	0	0	0	1	0.09
Sonoma	59	37	20	3	11	13	10	15	14	8	4.92
Stanislaus	2	0	1	1	0	3	1	0	0	1	0.24
Sutter	0	1	1	0	0	0	1	0	0	1	0.62
Tehama	0	1	0	1	0	0	1	1	0	2	1.21
Trinity	13	33	1	0	0	1	0	1	13	1	48.23
Tulare	0	3	1	3	1	1	0	1	1	0	0.35
Tuolumne	0	1	1	0	0	1	0	0	0	0	0.83
Ventura	1	2	1	0	0	0	0	2	1	2	0.13
Yolo	1	0	1	1	0	0	0	0	0	0	0.21
Yuba	2	1	0	3	1	0	0	1	1	0	1.72
Total	**265**	**228**	**134**	**68**	**80**	**65**	**154**	**135**	**139**	**95**	**0.46**

Source: California Department of Health Services

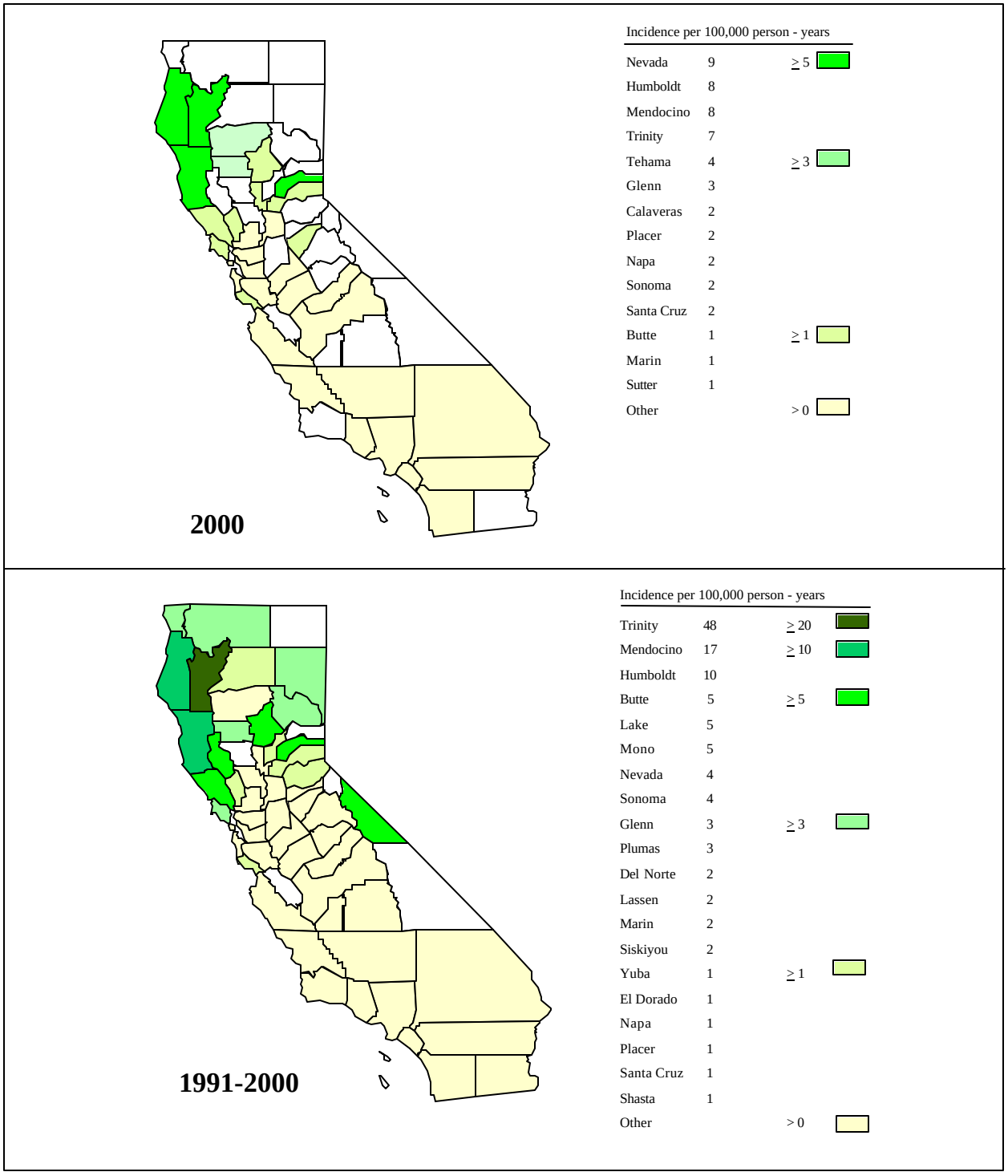

Figure 3. Reported incidence of Lyme disease by county, California.

Source: California Department of Health Services

Table 7. *Ixodes pacificus* nymphs and adults from California tested for evidence of *Borrelia burgdorferi*, 2000.

County and location of collection	Stage	No. ticks	No. pools	No. positive				Laboratory
				DFA	IFA	Culture	PCR	
Alameda								
Sunol Regional Park	A	25	5	-	1	-	-	Alameda Co. PHL
Del Norte								
Six Rivers NF	A	40	6	-	1	-	-	Washoe Co. EH
Six Rivers NF	A	6	-	-	0	-	-	Washoe Co. EH
Six Rivers NF	A	2	1	-	0	-	-	Washoe Co. EH
Fresno								
Sequoia NF	A	16	4	-	-	-	0	U.S. Army
Los Angeles								
Agoura	A	101	10	0	-	-	-	Orange Co. VCD
Angeles NF	A	11	3	-	-	-	0	U.S. Army
Malibu	A	118	12	-	5	-	-	Placer Co. HD
Malibu	A	103	-	0	-	-	-	Orange Co. VCD
Pacific Palisades	A	274	27	-	0	1	-	NIH Rocky Mt. Lab
Palos Verdes	A	52	5	-	1	-	-	Placer Co. HD
Rowland Heights	A	224	-	0	-	-	-	Orange Co. VCD
Monterey								
Los Padres NF	A	82	19	-	-	-	0	U.S. Army
Nevada								
South Yuba River SP	N	8	1	-	0	-	-	Placer Co. HD
South Yuba River SP	A	299	34	-	3	-	-	Placer Co. HD
Riverside								
Cleveland NF	A	64	9	-	-	-	0	U.S. Army
San Bernardino NF	A	289	30	-	-	-	0	U.S. Army
San Bernardino								
San Bernardino NF	A	4	1	-	-	-	0	U.S. Army
San Luis Obispo								
Los Padres NF	A	130	26	-	-	-	0	U.S. Army
Sonoma								
Sonoma	N	4	1	-	-	-	0	U.S. Army
Tulare								
Paradise Rec Area	A	7	1	-	-	-	0	U.S. Army
Sequoia NF	A	12	4	-	-	-	0	U.S. Army
Sequoia NF	N	2	1	-	-	-	0	U.S. Army
Sequoia NP	A	42	4	-	-	-	1	U.S. Army

Location: NF, National Forest
NP, National Park
SP, State Park

Stage: A, Adult
N, Nymph

Test: DFA, Direct fluorescent antibody
IFA, Indirect fluorescent antibody
PCR, Polymerase chain reaction

Laboratory: EH, Environmental Health
HD, Health Department
PHL, Public Health Laboratory
VCD, Vector Control District

Source: California Department of Health Services

Mosquito-borne Encephalitis Virus Surveillance

The California Mosquito-Borne Encephalitis Virus Surveillance Program is a cooperative effort of the California Department of Health Services' (DHS) Division of Communicable Disease Control, the University of California at Davis and Berkeley, the Mosquito and Vector Control Association of California (MVCAC), local mosquito and vector control agencies, local health departments, physicians, veterinarians, and other interested parties. In 2000, the surveillance system was expanded to allow for early detection of introduced mosquito-borne viruses, such as West Nile virus (WN). The enhanced surveillance system involves collaboration with several other agencies, including the California Department of Food and Agriculture (CDFA), California Department of Fish and Game (CDFG), and the United States Fish and Wildlife Service (USFWS).

In 2000 the program included the following components:

1) Testing of diagnostic specimens from human patients exhibiting symptoms of viral meningitis or encephalitis.
2) Enrolling patients diagnosed with encephalitis into the California Encephalitis Project (CEP) that evaluates demographics, exposure to arthropods, and laboratory analyses to determine etiology. Testing for antibody to WN was added to the Project protocol in 2000.
3) Diagnostic testing of specimens from domestic animal species that exhibited clinical signs of viral neurologic disease compatible with arboviral infection (western equine encephalomyelitis [WEE], St. Louis encephalitis [SLE], eastern equine encephalomyelitis [EEE], and WN as appropriate).
4) Monitoring and testing mosquitoes for SLE and WEE virus infection. Pools of mosquitoes positive for SLE also were tested for WN.
5) Monitoring of sentinel chickens for seroconversion to SLE and WEE in areas of California where encephalitis virus historically has been active. Some of the chickens that were SLE seropositive also were tested for WN.
6) Surveillance and diagnostic testing of dead birds, especially crows, for WN.
7) Weekly reporting in the DHS Arbovirus Surveillance Bulletin of surveillance data from California and the United States.

Human disease surveillance

The DHS Viral and Rickettsial Disease Laboratory (VRDL) tested for antibodies to SLE and WEE viruses 226 serum and/or cerebrospinal fluid specimens from patients exhibiting symptoms of viral meningitis or encephalitis. Neither elevated IgM antibody nor a four-fold rise in total antibody between paired sera was observed in specimens from any of the suspect cases.

The CEP enrolled 370 patients from June 1998 to December 2000 (170 in 2000). For each patient enrolled, a core battery of tests was conducted, including polymerase chain reaction, serology, and isolation for 15 agents. Testing for additional etiologic agents was pursued as clinical symptomatology and exposure history warranted; extensive testing for arboviruses was conducted for cases with known mosquito exposure. No cases of SLE or WEE were identified through the CEP. Assays for antibody to WN were performed for all patients enrolled in 2000, as well as 36 patients enrolled in 1998 or 1999. Of these patients, six had traveled to the eastern United States within the incubation time consistent with arboviruses, and two of the six had been

bitten by mosquitoes during their travels. An additional seven patients had a history of recent mosquito bites. No cases of WN were identified.

Equine surveillance and a case of eastern equine encephalomyelitis

Serum and brain tissue specimens from a total of 15 horses displaying neurological signs were submitted to VRDL for arboviral testing in 2000. Testing failed to detect antigen or antibody for WEE, EEE, or WN.

In late April, a 16-month-old horse in Ventura County was euthanized after developing progressive neurologic signs. Eastern equine encephalomyelitis virus (EEE) was isolated from the horse's brain at the National Veterinary Service Laboratory, U.S. Department of Agriculture in Ames, Iowa. Virus isolation was attempted and subsequently confirmed by VRDL and the University of California Davis (UCD) Center for Vector-Borne Disease Research. The horse had traveled to shows in Utah and southern California in the month preceding onset of illness. This horse and 27 others at the barn were vaccinated seven days prior to the case's illness onset with a commercial four-way multi-dose EEE/WEE/rhinopneumonitis/tetanus vaccine.

DHS coordinated an investigation of this case with the Ventura County veterinarian, Ventura County health officer, City of Moorpark Vector Control District, and the Ventura County Vector Control Program within the Environmental Health Department. Sera from a sentinel chicken flock on the farm where the horse was stabled were negative for EEE, SLE, and WEE antibody. Carbon dioxide traps were placed immediately on and within a five-mile radius of the farm for a total of 23 trap nights, but only a small number of mosquitoes were collected. Mosquito pools were submitted to the Arbovirus Research Unit (DARU) of the UCD Vector-Borne Disease Research for virus isolation. New Jersey light trap collections were also sent to DARU for testing by reverse transcriptase polymerase chain reaction (RT-PCR). All the mosquitoes tested negative for EEE. Although attempts to isolate live virus from residual and archived samples of vaccine were unsuccessful, the paucity of evidence for natural (ie, mosquito) transmission in the area suggests that an incompletely inactivated vaccine was the most likely source of infection for this horse.

Mosquito testing

Local agencies initiated mosquito collections by New Jersey light traps in April 2000. Data from these sources were forwarded to DHS and collated weekly in the Adult Mosquito Occurrence Summary Report (AMOR) from April 13 to November 2, 2000.

Twenty-eight local mosquito control agencies in California submitted a total of 160,947 mosquitoes (3,901 pools) in 2000 (Tables 8, 9, & 10). Mosquitoes were tested for arboviruses at DARU by an in situ enzyme immunoassay using Vero cell culture. Thirty pools were positive for SLE, but none was positive for WEE (Figure 4). The 30 SLE positive pools also were tested for WN and found to be negative.

Chicken serosurveillance

In 2000, 43 local mosquito and vector control agencies in California maintained 170 sentinel chicken flocks. Blood specimens were collected and tested biweekly from each flock. A total of 18,560 chicken sera from California, and 2,225 sera from Nevada, Oregon, Utah, Washington and Arizona, were tested for antibody to WEE and SLE.

A total of 49 seroconversions to SLE were recorded among nine sentinel chicken flocks in Imperial (11 total seroconversions), Riverside (36), and San Bernardino (2) Counties (Table 11; Figure 5 & 6). The first SLE seroconversion was detected in five chickens bled on July 3 in Riverside County (North Shore, CA). The last seroconversion for 2000 was in Riverside County (Blythe, CA) on October 12. Because chicken IgG antibody to SLE cross-reacts with WN, SLE-positive chickens were subsequently tested for WN; all were negative. There were no seroconversions to WEE in 2000. This was only the second year since the chicken serosurveillance program was initiated in 1979 in which no seroconversions to WEE were detected.

Dead bird surveillance for West Nile virus

A dead bird surveillance program for WN was initiated in September 2000 in conjunction with a grant received from the Centers for Disease Control and Prevention (CDC). In September, DHS notified approximately 600 agencies and organizations of the program and requested that they contact DHS when dead birds, especially crows, were sighted. Recipients of the mailing included the CDFA, CDFG, USFWS, wildlife rehabilitation and refuge centers, veterinarians, the Audubon Society, animal control and environmental health officers, local health departments, and mosquito and vector control districts. Necropsies of submitted carcasses were performed by the CDFA California Animal Health and Food Safety Laboratory. Kidney, brain, and heart samples were forwarded to DARU for testing via cell culture and PCR.

A total of 40 dead birds were reported to DHS from Los Angeles, Tehama, Kern, San Joaquin, San Bernardino, Placer, San Francisco, Riverside, Fresno, and Santa Barbara Counties. Twenty of these met criteria for testing; all were negative for WN.

Reporting arbovirus surveillance data

Mosquito pool and sentinel chicken test results were summarized in weekly arbovirus surveillance bulletins from May 11 to December 19. Reports were distributed to all surveillance program participants and other interested parties. Positive serologies and mosquito pools were communicated immediately by telephone to the submitting agencies.

California State Mosquito-Borne Virus Surveillance and Response Plan

DHS, the MVCAC, and the University of California developed an enhanced surveillance and response program for the State of California to ensure that local and state agencies are prepared to detect and respond in a concerted effort to a mosquito-borne disease outbreak. This plan includes a mosquito-borne virus risk assessment model that defines three response levels and the conditions indicative of each level. A final version of the plan document may be found at www@dhs.ca.gov.

West Nile virus in the eastern United States

In 1999, WN activity was reported in New York, New Jersey, Connecticut, and Maryland. In 2000, in addition to these states, WN was detected in Delaware, Massachusetts, New Hampshire, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia, and the District of Columbia. WN surveillance included humans, equids, other mammals, birds, mosquitoes, and sentinel chicken flocks. In 2000 there were 21 human cases of WN encephalitis with two fatalities. This represents a decrease in case numbers from 1999 when 62 cases with 7 fatalities were detected.

Report prepared by Stan Husted, Aline Cornelius, Vicki Kramer, and Malcolm Thompson

Table 8. Mosquitoes (*Culex* spp. and *Aedes melanimon*) tested for WEE and SLE viruses by submitting county & agency, 2000.

		Ae melanimon		*Cx pipiens*		*Cx quinquefasciatus*		*Cx stigmatosoma*		*Cx tarsalis*		*Total*	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Contra Costa	CNTR	29	1.432							284	14.153	313	15.585
Fresno	CNSL									10	500	10	500
Fresno	FRNO									7	264	7	264
Glenn	GLEN									20	1.000	20	1.000
Kern	KERN	148	6.314							364	9.696	512	16.010
Kings	KNGS									23	1.129	23	1.129
Lake	LAKE	6	300					3	52	111	5.140	120	5.492
Los Angeles	GRLA					363	13.836			72	2.784	435	16.620
Los Angeles	LONG					368	14.374	3	49	201	7.742	572	22.165
Madera	MADR			9	450					2	100	11	550
Merced	TRLK									5	226	5	226
Orange	ORCO					117	3.267			9	230	126	3.497
Placer	PLCR									19	788	19	788
Riverside	COAV	19	869							544	23.928	563	24.797
Riverside	NWST					181	8.936	4	166	128	6.266	313	15.368
Sacramento	SAYO	6	177							63	2.188	69	2.365
San Bernardino	SANB					13	377	4	84	73	3.342	90	3.803
San Diego	SAND									50	2.477	50	2.477
San Joaquin	SJCM									114	5.495	114	5.495
Santa Barbara	SBCO					21	919	5	194	49	2.368	75	3.481
Shasta	SHAS									64	3.175	64	3.175
Stanislaus	TRLK	1	50							32	1.457	33	1.507
Sutter	SUYA	14	556							147	6.466	161	7.022
Tulare	DLTA					4	163			10	226	14	389
Ventura	MOOR			2	3	1	18	4	58	5	58	12	137
Ventura	VENT									20	954	20	954
Yolo	SAYO	1	50							71	3,212	72	3.262
Yuba	SUYA									15	617	15	617
Grand Total		**224**	**9.748**	**11**	**453**	**1.068**	**41.890**	**23**	**603**	**2.512**	**105.981**	**3.838**	**158.675**

Table 9. Mosquitoes (Other *Aedes* spp.) tested for WEE and SLE viruses, by submitting county & agency, 2000.

		Ae hexodontus		*Ae sierrensis*		*Ae taeniorhynchus*		*Ae washinoi*		*An franciscanus*		*An hermsi*		*Total*	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Contra Costa	CNTR	1	50											1	50
Sacramento	SAYO			9	233									9	233
Santa Barbara	SBCO					14	633	6	194	1	50	10	441	31	1,318
Total		**1**	**50**	**9**	**233**	**14**	**633**	**6**	**194**	**1**	**50**	**10**	**441**	**41**	**1,601**

Table 10. Mosquitoes (*Culiseta* spp. and *Culex erythrothorax*) tested for WEE and SLE viruses, by submitting county and agency, 2000.

		Cs incidens		*Cs inornata*		*Cs particeps*		*Cx erythrothorax*		*Cx restuans*		*Total*	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Santa Barbara	SBCO	2	39	1	14			14	573	1	19	18	645
Ventura	MOOR					1	2	3	24			4	26
Total		**2**	**39**	**1**	**14**	**1**	**2**	**17**	**597**	**1**	**19**	**22**	**671**

Source: California Department of Health Services

Table 11. Chicken seroconversions to SLE by location and date bled, 2000.

County	Location	City	7/3	7/6	7/17	7/31	8/14	8/28	9/7	9/11	9/25	10/9	10/10	10/12	11/28	**Total**
Imperial	Cady	Brawley		1			5		1							**7**
Imperial	Campbell	Seeley		1			3									**4**
Riverside	4th Avenue	Blythe												1		**1**
Riverside	Adohr	Mecca						1		3	2	2				**8**
Riverside	Desert	North Shore	5		2	2	1								1	**11**
Riverside	Gordon	Mecca					2			7						**9**
Riverside	Mecca	Mecca									1					**1**
Riverside	SSSP	North Shore			2	1	1			1					1	**6**
San Bernardino	Treatment Pl.	Needles								1			1			**2**
SLE Totals			**5**	**2**	**4**	**3**	**12**	**1**	**1**	**12**	**3**	**2**	**1**	**1**	**2**	**49**

Source: California Department of Health Services

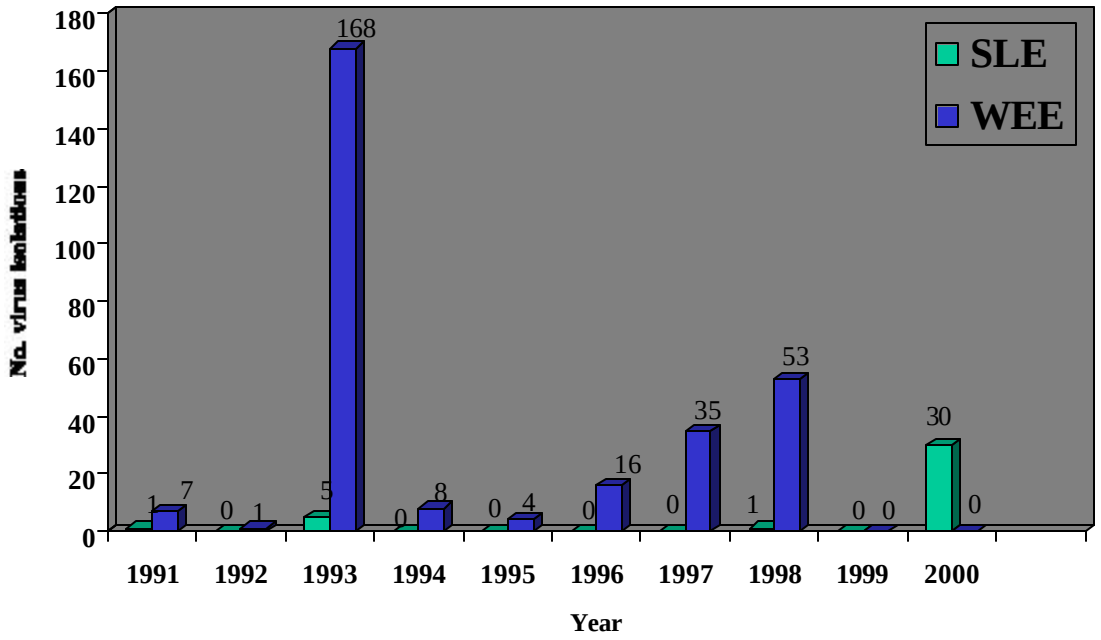

Figure 4. Isolations of St. Louis encephalitis (SLE) and Western equine encephalomyelitis (WEE) viruses from pooled *Culex tarsalis* in California, 1991-2000.

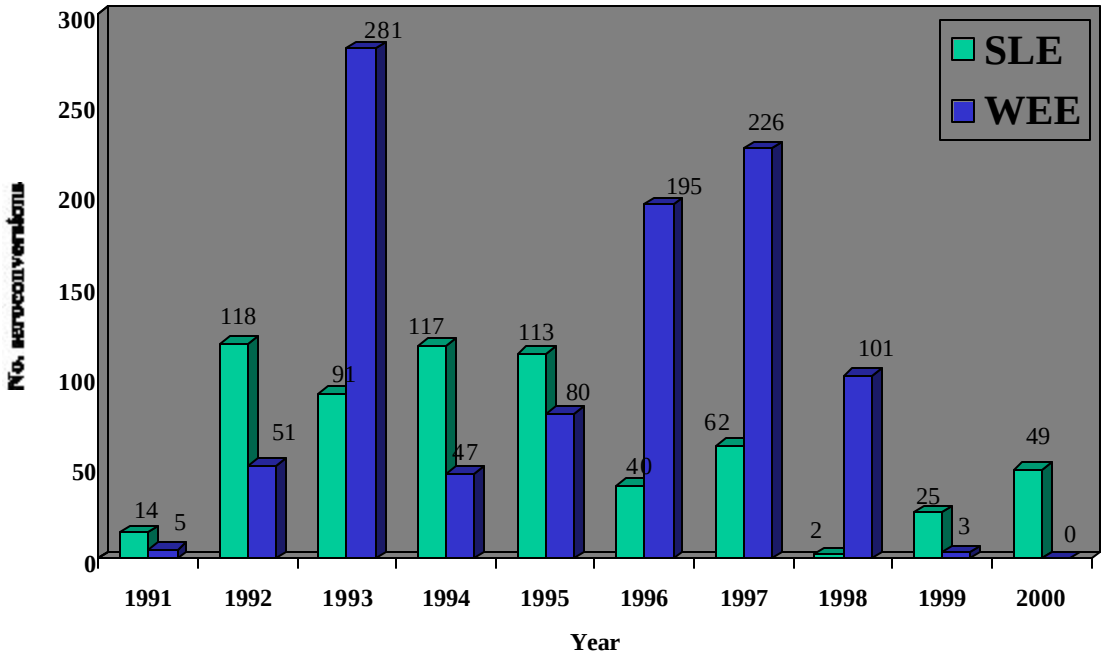

Figure 5. Seroconversions to St. Louis Encephalitis (SLE) and Western equine encephalomyelitis (WEE) viruses in sentinel chicken flocks in California, 1991-2000.

Source: California Department of Health Services

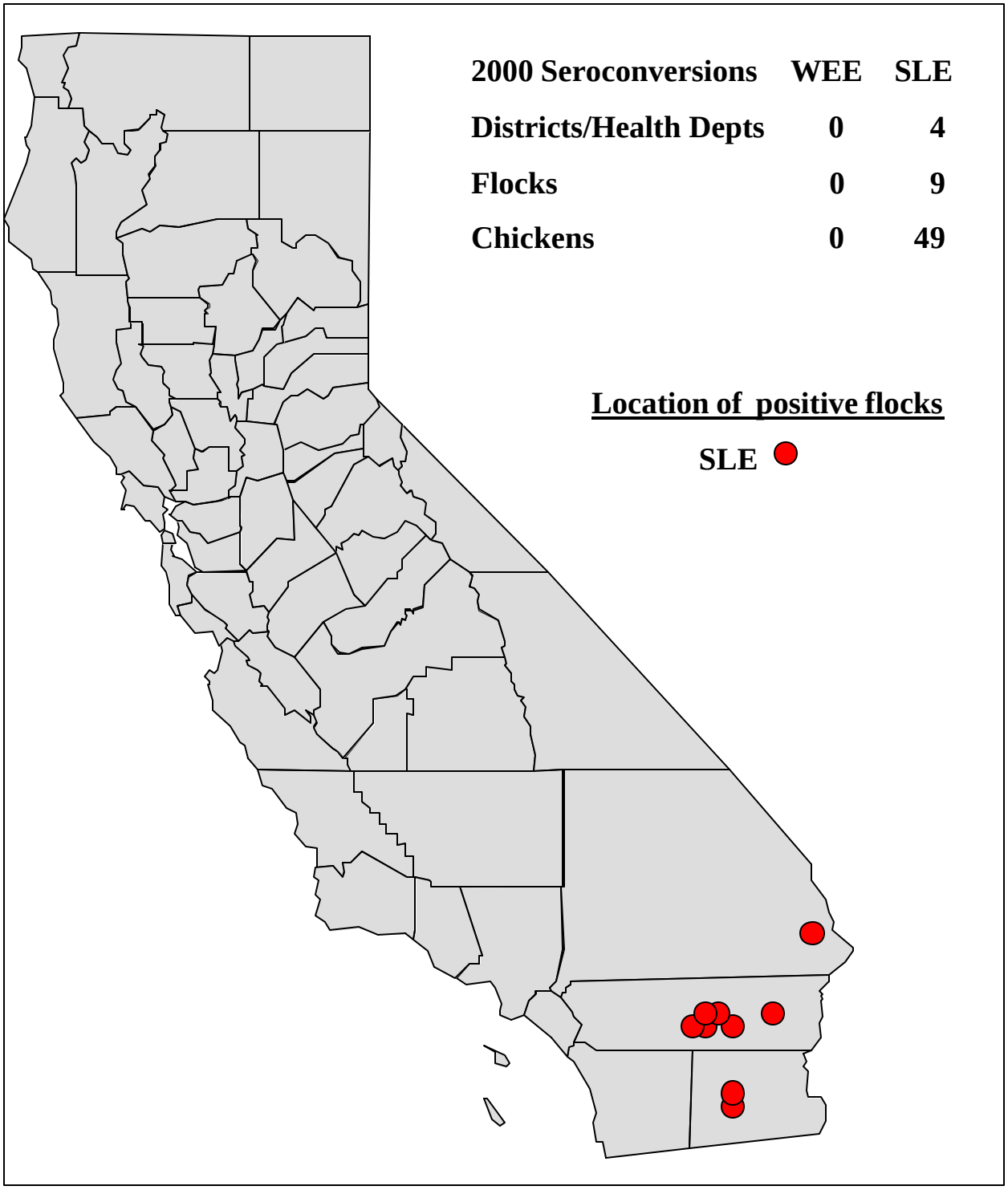

Figure 6. Sentinel chicken flocks with at least one seroconversion to St. Louis encephalitis (SLE), California, 2000.

Source: California Department of Health Services

United States Forest Service Activities

In 1992, the Vector-Borne Disease Section (VBDS) entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region of the United States Department of Agriculture Forest Service to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. The United States Forest Service (USFS) and VBDS established this agreement to achieve mutually beneficial objectives in pest control and management, mandated by both federal and state law. VBDS and the USFS agreed to work cooperatively in planning and implementing vector-borne disease management programs.

In accordance with this agreement, VBDS staff conducted field activities in the following National Forests in 2000: Angeles, Cleveland, Eldorado, Humboldt-Toiyabe, Inyo, Klamath, Lake Tahoe Basin Management, Lassen, Los Padres, Mendocino, Modoc, Plumas, San Bernardino, Sequoia, Shasta-Trinity, Sierra, Six Rivers, Stanislaus, and Tahoe. These activities included investigations of three cases (one fatal) of hantavirus which were acquired on or near USFS land and one case of plague which was acquired near USFS land. In addition, VBDS provided consultation, certification, and oversight to autonomous agencies (environmental health departments and vector control agencies) concerning vector-borne diseases and pesticide applications for public health purposes on USFS land.

Activities conducted by VBDS staff in National Forests include disease surveillance, risk assessment, risk reduction, and education of USFS personnel and concessionaires. Direct surveillance included the collection and testing of indicator species and vectors for hantavirus, plague, Lyme disease, and other tick-borne diseases (Table 12); indirect surveillance included visual assessment of vector-borne disease risk (e.g., counting active rodents and evaluating rodent burrows for abandonment). Based on surveillance information, risk reduction recommendations for vector-borne diseases were made for recreational areas, fire lookouts, employee residences, and work places. Recommendations included control of vectors, rodent management, and habitat modification. Vector suppression actions involving pesticides included training on pesticide safety for USFS personnel or other groups who participated in the control effort. Follow-up evaluations were made to determine whether the risk of contracting a vector-borne disease had been adequately reduced. Educational activities involved providing information on specimen collection and risk assessment. Posters and brochures on plague, hantavirus, and Lyme disease were distributed to ranger district offices and individual campgrounds in regions endemic for these diseases. In addition, VBDS provided mid-year and annual California Plague Reports to the USFS regional office and all Forest Supervisors' offices. This report details information on VBDS activities in individual National Forests in 2000.

Table 12. Laboratory testing of specimens collected on USFS lands, 2000.
(No. specimens positive / No. specimens tested)

National Forest	Hantavirus surveillance (rodents)	Plague surveillance (rodents)	Plague surveillance (carnivores)[1]	Lyme disease Surveillance (ticks)	Other pathogen surveillance (ticks)
Angeles			8/9	0/70	
Cleveland	0/100		0/42	0/64	0/64[2]
Eldorado		0/4	4/62		
Humboldt-Toiyabe			0/1		
Inyo	0/1	5/62	0/1		
Klamath			0/5		60[4]
Lassen			0/3		
Los Padres	1/8	7/99	2/28	0/212	0/197[2], 6/197[3], 131[4]
Mendocino			0/16		
Modoc			7/38		
Plumas	4/66		5/19		
San Bernardino	0/37	7/219	2/35	0/293	0/289[2]
Sequoia		0/34	3/10	0/30	
Shasta-Trinity			5/31		
Sierra			1/32		
Six Rivers			0/4	1/48	
Tahoe	0/20	13/44	4/62		
Total all forests:	5/232	32/462	41/398	1/717	0/550[2], 6/197[3], 191[4]

[1]Carnivore specimens taken directly from or immediately adjacent to USFS lands. Because of the broad home range of carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands. Many of these specimens were collected by USDA Wildlife Services through a contractual agreement with DHS.

[2]*Ixodes pacificus* ticks tested for infection with *Ehrlichia chaffeensis* and *E. equi* (ehrlichioses).

[3]*Ixodes pacificus* ticks tested for infection with *Borrelia* spp.

[4]*Dermacentor occidentalis* ticks tested for infection with *Bartonella* spp. Results are pending.

Source: California Department of Health Services

Activity summary by individual National Forests

Angeles National Forest

- Conducted Lyme disease surveillance in the areas of Big Dalton Canyon, Evey Canyon, Palmer Canyon, and Webb Canyon. Western black-legged ticks (*Ixodes pacificus*) were collected at all sites. However, none of 59 ticks tested was infected with *Borrelia burgdorferi* (the causative agent of Lyme disease).
- Conducted tick surveillance at Switzer, Mescal, Vogel, Stonyvale, Silverwood and Wildwood picnic areas, as well as Red Box, Shoening Spring, Hidden Spring, and Sycamore Flat campgrounds. None of 11 *I. pacificus* collected was infected with *B. burgdorferi*.
- Sampled ticks and conducted visual plague surveillance at Manker's Flat campground. No ticks were collected. Ground squirrel density was very low.
- Evaluated plague risk at Jackson Lake picnic area and Table Mountain, Pea Vine, Lake, and Mountain Oaks campgrounds. Ground squirrel populations were low at all sites. Risk of plague transmission at these sites was considered low.
- Discussed methods for reducing ground squirrel populations with USFS personnel from Lytle Creek Ranger Station.
- Discussed vector-borne disease issues and risk reduction with USFS personnel at the Mount Baldy Visitor's Center.
- Contacted the Forest Supervisor at Oak Grove Park Ranger District to discuss vector-borne disease epidemiology and risk reduction methods.

Cleveland National Forest

- Collaborated with the Riverside County Environmental Health Department (EHD) to test *I. pacificus* ticks for evidence of infection with *B. burgdorferi*, *Ehrlichia chaffeensis*, and *E. equi*. Ticks were collected in the Ortega Mountains and along the Santa Rosa Plateau. None of 64 ticks tested was infected with *B. burgdorferi*, *E. chaffeensis*, or *E. equi*.
- Collaborated with the Northwest Mosquito Abatement District, the Riverside County EHD and the San Diego County EHD to test rodents for evidence of hantavirus infection. Rodents were trapped throughout the range of Cleveland NF. There was no evidence of hantavirus infection in 100 rodents tested.

Eldorado National Forest

- Collaborated with the El Dorado County EHD to test ground squirrel and chipmunk carcasses found at NF campgrounds for evidence of infection with plague bacteria (*Yersinia pestis*). None of the four carcasses tested was infected with plague bacteria.
- Evaluated plague risk at Big Meadows, Silver Creek, Ice House, Northwind, Strawberry Point, Cleveland Corral, Jones Fork, Sunset, Fashoda, Wench Creek, Yellowjacket, South Fork, Gerle Creek, Loon Lake, Chalet, North Shore, Wrights Lake, Crystal Basin Ranger Station, and Mountain Camp II campgrounds. Ranger district personnel and concessionaires were briefed on risk factors and plague caution signs were posted where VBDS biologists deemed it appropriate.

- Evaluated plague risk at Lumberyard, Pipi, Pardoes Point, Caples Lake, Kirkwood, Silver Lake, South Shore, Sugar Pine Point, and Woods Lake campgrounds. Plague risk was discussed with ranger district representatives and concessionaires, and plague caution signs were posted.

Humboldt-Toiyabe National Forest

- Surveyed and evaluated Hope Valley, Kit Carson, Snow Shoe Springs, Crystal Springs, Markleeville, and Silver Creek campgrounds for plague risk. Plague caution signs were posted and disease epidemiology and risk reduction discussed with USFS personnel and concessionaires.
- Visually surveyed Trumbull Lake campground for rodent activity and plague risk. Risk of plague transmission was determined to be low at this site due to low ground squirrel density.

Inyo National Forest

- Conducted tick and rodent surveillance for Lyme disease at Lewis Canyon, Cottonwood Canyon and Sage Flat. Ear biopsy samples and rodent sera of woodrats and deer mice were collected and tested in collaboration with the University of California for infection with *Borrelia* spp. A new *Borrelia* sp. infecting rodents was identified at these sites during 1999 by VBDS biologists in collaboration with researchers at the University of California.
- Investigated a fatal human hantavirus case with possible exposure near Yosemite National Park. VBDS biologists contacted Lee Vining Fire Station personnel to discuss hantavirus risks. Several station buildings were evaluated and one woodrat was captured, and sampled; the tested woodrat was not infected with hantavirus.
- Collaborated with health departments in Los Angeles and Ventura counties to investigate two non-fatal human hantavirus cases with possible exposure on or near USFS land in Mono County. Case-patients were known to have visited USFS land in Mono county prior to seeking medical attention at hospitals in Los Angeles and Ventura, their counties or residence.
- Conducted plague surveys in collaboration with Inyo County EHD and Mono County Department of Health at Willows, Four Jeffrey, Forks and New Shady Rest campgrounds. One of 15 ground squirrels and none of five chipmunks tested from Four Jeffrey campground was infected with plague bacteria. The flea index at this site was high (13.5 fleas per ground squirrel). One of 13 ground squirrels and three of seven chipmunks was infected with plague at New Shady Rest Campground. The flea index of rodents at this site was low (less than one flea per rodent). None of the 22 ground squirrels or chipmunks collected at Willows or Forks campground was infected with plague bacteria. Follow-up flea control was conducted at Four Jeffrey campground using Diazinon 2D dust applied to 277 rodent burrows. Flea control was not conducted at New Shady Rest due to a low flea index and a low risk of plague transmission.
- Visually surveyed eastern Sierra Nevada campgrounds for plague risk. Survey included Oh! Ridge, Lower Lee Vining, Cattleguard, Moraine, Boulder, Aspen, Big Ben, Shady Rest, Pine Glen, Sage Flat, Upper Sage Flat, Big Pine Creek, Palisade Glacier, Clyde Glacier, Lower

Grays Meadow, Upper Grays Meadow, Onion Valley, Oak Creek, Lone Pine, and Whitney Portal campgrounds. None of these campgrounds appeared to have a high risk for plague transmission.

- Conducted visual inspections of Boulder, Aspen, and Big Ben Campgrounds to determine plague risk at these sites. Plague risk was considered low at all campgrounds due primarily to low rodent activity. Ensured that all campgrounds were posted with plague caution signs due to the historical presence of the disease in this area.
- Evaluated eastern Sierra Nevada campgrounds for rodent activity and plague risk. Visual surveys included Big Trees, Table Mountain, Mountain Glen, Intake, Bishop Park, Sabrina, North Lake, Grandview, Cedar Flat, Rock Creek Lake, Lower Corral, Upper Pine Grove, Pine Grove, East Forks, Palisades, Big Meadow, Iris Meadow, Aspen Group, Holiday, French Camp, Tuff, Crowley Lake Fish Camp, McGee Creek, Convict Lake, Sherwin Creek, New Shady Rest, Old Shady Rest, Big Pine, Tinnemaha Creek, Independence Creek, Diaz Lake, June Lake, Reversed Creek, Gull Lake, Big Spring, Lower and Upper Deadman, Silver Lake, and Grand Lake campgrounds. All campgrounds appeared to have a low risk for plague transmission to humans.
- Met with USFS, Bureau of Land Management (BLM), and Inyo County EHD officers to discuss vector-borne diseases in Inyo County. Developed action plans to increase surveillance and education in the largely rural county.
- Discussed vector-borne disease epidemiology with USFS personnel at White Mountain Ranger Station. Provided literature and plague warning signs for posting.

Klamath National Forest

- Conducted tick-borne disease surveillance at Tree of Heaven and West Branch campgrounds. Sixty *Dermacentor occidentalis* ticks were collected at Tree of Heaven. These ticks were tested at the University of California for infection with *Bartonella* bacteria. Results of testing are still pending.
- Inspected Oak Knoll and Mt. Hebron Fire Stations for hantavirus risk. Inspected areas included workshops, storage areas, and living spaces. Provided recommendations on food storage to minimize attractiveness to rodents of living areas and kitchens. Discussed hantavirus epidemiology and risk factors with fire captains and with USFS staff at Goosenest Ranger Station.
- Surveyed Juanita Lake and Martin's Dairy campgrounds for plague risk. Although risk for plague appeared low, both campgrounds were posted with plague warning signs due to historical evidence of plague at these sites.

Lake Tahoe Basin Management

- Evaluated plague risk at Fallen Leaf, Kaspian, Meeks Bay, and William Kent campgrounds. Ranger district representatives and concessionaires were briefed on risk factors and plague caution signs were posted where appropriate.

Lassen National Forest

- Investigated plague infection in three coyotes trapped near Hat Creek Ranger District. Surveyed Hat Creek District campgrounds (Cave, Rocky, Bridge, and Honn campgrounds) for plague risk. Contacted Hat Creek Ranger District office as well as camp hosts to discuss risk assessment findings. Recommended posting of plague warning posters at campgrounds.
- Surveyed 11 campgrounds in the Almanor and Eagle Lake Ranger Districts for risk of plague. Sites surveyed included Lake Almanor, Guernsey Creek, Mill Creek, Battle Creek, Domingo Springs, High Bridge, Warner Creek, and four Eagle Lake campgrounds. Risk was considered low at all of these sites. However, plague warning signs were posted due to the historical presence of plague at these sites.
- Evaluated rodent densities to determine risk for transmission of plague and hantavirus at Roxie Peconom campground. The campground was posted with plague caution signs and campground hosts were provided with literature on plague and hantavirus.
- Contacted Hat Creek, Almanor, and Eagle Lake Ranger Districts to discuss vector-borne disease issues. Provided literature to districts on the epidemiology of Lyme disease, hantavirus, and plague. Plague caution signs were also provided for posting of campgrounds and picnic areas.

Los Padres National Forest

- Conducted tick-borne disease surveillance at Arroyo Seco campground and along the Arroyo Seco trail. None of 82 *I. pacificus* ticks collected was infected with *B. burgdorferi*. Of 67 *I. pacificus* ticks tested, none was infected with *E. chaffeensis* or *E. equi*, but five were infected with an undetermined *Borrelia* sp. (not *B. burgdorferi*). Additionally, 131 *D. occidentalis* ticks were collected from this site and, in collaboration with the University of California, are being tested for evidence of infection with *Bartonell*a bacteria. These results are pending.
- Conducted tick-borne disease surveillance at Cerro Alto campground. Of 130 *I. pacificus* ticks collected, none was infected with *B. burgdorferi*, *E. chaffeensis*, or *E. equi*. However, one tick was infected with an undetermined *Borrelia* sp. (not *B. burgdorferi*).
- Conducted hantavirus surveillance at Romero Canyon and along north Tunnel Road. One of three *Reithrodontomys megalotis* and none of five *Peromyscus* mice was infected with hantavirus.
- Visually surveyed rodent activity at Ponderosa and Nacimiento campgrounds to identify risk for plague transmission. Additionally, conducted tick surveys at these campgrounds. No *Ixodes* ticks were captured indicating a low risk for Lyme disease at these sites.
- Conducted site survey and indirect surveillance for plague and Lyme disease activity at Wheeler Gorge. Disease risk was estimated to be low.
- Conducted plague surveillance at McGill and Mt. Pinos campgrounds. One of ten ground squirrels and none of five chipmunks captured at McGill campground and tested for plague was infected with plague bacteria. None of 13 ground squirrels and chipmunks captured at Mt. Pinos campground was infected with plague bacteria. Flea control was initiated at McGill campground using Diazinon 2D dust placed into rodent burrows. Literature was provided to the camp host and plague warning signs were posted at the campground entrance.

- Conducted plague surveillance at Upper Oso campground. None of 18 ground squirrels tested was infected with plague bacteria.
- Completed evaluation of the effectiveness of a chitin synthesis inhibitor (lufenuron) to control fleas on rodents at Chuchupate campground. These trials demostrated significant reduction in flea numbers on rodents following treatment. Plans were prepared to continue this work and refine the techniques.
- Conducted flea control in preparation for work crews to open Chuchupate campground. Discussed with USFS personnel the need for posting plague warning signs and ensuring ongoing flea control at this site. Plague and hantavirus risk reduction training was provided to youth groups participating in brush clearing and campground cleaning. Due to the successful reduction of plague risk, this site was reopened after 18 years of closure.
- Conducted end of season plague surveillance at Chuchupate campground to determine effectiveness of summer long flea control program. Although six of 53 rodents tested had antibodies to plague, the very low flea index suggests that these rodents had antibodies from a past plague infection and were not currently infected with plague.
- Visually surveyed White Oaks, China Flat, Kirk Creek, Prewitt Ridge, Plaskett Creek, Mt. Pinos, Sage Hill, and Paradise campgrounds for rodent activity and plague risk. All campgrounds had low or no apparent plague risk.

Mendocino National Forest

- Surveyed Fouts, Mill Creek, Dixie Glade, and Letts Lake campgrounds for rodent and tick activity. Rodent activity was low at all sites. The density of *I. pacificus* ticks was relatively high at Fouts and Mill Creek. The risk for Lyme disease was considered moderate at these sites due to the high population of ticks.
- Discussed tick transmitted diseases with USFS personnel at the district ranger station. Provided educational information for dissemination to other USFS employees.
- Visually inspected campgrounds surrounding Lake Pillsbury (Sunset, Oakflat, Fuller Grove, Pogie Point, and Navy Camp campgrounds) for rodent activity and plague risk. Rodent populations at these sites were very low and there was little risk of plague transmission.

Modoc National Forest

- Conducted tick surveillance north of Day to ascertain whether *I. pacificus* is present in Modoc County. No *I. pacificus* ticks were collected.
- Assessed Medicine Lake Fire Station for risk of hantavirus transmission. Discussed with fire station personnel and staff at Tule Lake Ranger District recommendations for rodent-proofing storage buildings.
- Evaluated a storage facility at Dry Lake Fire Station for hantavirus risk. Discussed risk management with the Fire Captain and the Province Safety Officer and provided training on proper cleanup methods.
- Evaluated rodent densities at A. H. Hogue, Headquarters, Hemlock, Medicine Lake, Howards Gulch, Upper Rush Creek, Lower Rush Creek, Cedar Pass, and Stough Reservoir campgrounds to determine risk for transmission of plague and hantavirus. Campgrounds were posted with plague caution signs and campground hosts were provided with plague and hantavirus literature.

- Contacted Warner Mountain Ranger District and the Modoc National Forest Supervisor's office in Alturas to discuss vector-borne disease issues. Provided literature on the epidemiology of Lyme disease, hantavirus, and plague. Also provided plague caution signs for posting at campgrounds and USFS day use areas.

Plumas National Forest

- Conducted tick surveillance at Gansner Bar, North Fork, and Queen Lily campgrounds along the north fork of the Feather river. Very few ticks were collected and deer activity appeared low. Risk for Lyme disease was considered low.
- Evaluated Lauffman Fire Station as a potential site for a long-term hantavirus study to describe dynamics of infection in deer mice and to identify risk factors associated with transmission of this disease. Deer mice infected with hantavirus have been recovered previously from this site. Discussed study design and requirements with the Province Safety Officer and the station fire captain. Also provided recommendations to reduce risk of hantavirus transmission during building renovations at this site.
- Initiated long-term hantavirus project at Lauffman Fire Station. Rodents were trapped, bled, marked, and released. Three of 42 rodents collected during this initial sampling were infected with hantavirus. USFS personnel and the Province Safety Officer were notified of the findings. During subsequent sampling, an additional one of 24 rodents was infected with hantavirus. This site was sampled twice during 2000 and will be sampled quarterly over the next several years to better understand the ecology of hantavirus in California and the associated human risks.
- Evaluated plague risk at four campgrounds on Frenchman Reservoir. High numbers of golden- mantled ground squirrels were noted. Risk of plague transmission was considered moderate.
- Surveyed Lakes Basin campground in the Sierra Buttes region for rodent activity. Although plague risk appeared low, the campground was posted with plague warning signs due to the history of plague in the area.
- Presented seminar to Fire Management staff on the epidemiology of hantavirus, Lyme disease, and relapsing fever. Discussed the hantavirus respiratory program to be implemented in Plumas, Modoc, and Lassen National Forests by the Province Safety Officer.
- Contacted Mt. Hough, Oroville, and Beckwourth Ranger Districts to discuss vector-borne disease issues. Provided literature on Lyme disease, hantavirus, and plague. Also provided plague caution signs for posting at campgrounds and day-use areas within these districts.

San Bernardino National Forest

- Collaborated with the Riverside County EHD and San Bernardino Vector Control Program (VCP) to test ticks for evidence of infection with *B. burgdorferi*, *E. chaffeensis*, and *E. equi*. Ticks were collected at Gardner Valley, Silent Valley, Cranston Station, Seven Oaks campground, and Silverwood Lake recreation area. None of 293 *I. pacificus* ticks collected was infected with *B. burgdorferi*, and none of 289 ticks tested was infected with either *E. chaffeensis* or *E. equi*.

- Surveyed Middle Fork trailhead in the Cucamonga Wilderness for tick presence. No *Ixodes* ticks were collected at this site.
- Tested rodents for evidence of hantavirus infection from campgrounds and trailheads throughout the National Forest in collaboration with Los Angeles County Department of Health Services, the San Bernardino VCP, and the Riverside County EHD. None of 37 rodents tested was infected.
- Evaluated hantavirus risk at Vista Grande Fire Station in the San Jacinto Ranger District. Provided written report to fire captain and district supervisor on findings and recommendations to reduce risk of hantavirus infection for USFS fire personnel.
- Inspected buildings at four fire stations in the San Jacinto Ranger District for rodent activity and risk of hantavirus transmission. *Peromyscus* mouse activity was observed in a majority of the buildings, indicating a potential for hantavirus transmission. USFS personnel were provided information about hantavirus epidemiology, and techniques for cleanup and sanitation of rodent infestation.
- Tested rodents for evidence of plague from campgrounds and trailheads throughout the National Forest, in collaboration with the Los Angeles County Department of Health Services, the San Bernardino VCP, and the Riverside County EHD. Of 201 rodents tested, plague was detected in one ground squirrel from Boulder Basin campground and six ground squirrels from Marion Mountain campground. These findings led to treatment of these campgrounds by VBDS and Riverside County EHD personnel. Diazinon 2D dust was placed in rodent burrows to control ground squirrel fleas. Post-treatment flea indices were low and the campgrounds were allowed to remain open.
- Conducted plague surveys at Apple White campground in conjunction with USFS personnel from the Lytle Creek Ranger Station. Ground squirrel populations were high, but none of 18 ground squirrels captured was infected with plague.
- Conducted visual rodent surveillance at Teresita Picnic Area and Apple White Campground. Surveys were conducted in the evening and rodent densities appeared low.
- Contacted USFS personnel at Front Country Ranger District to discuss vector-borne disease epidemiology and risk reduction methods.

Sequoia National Forest

- Sampled ticks from USFS land at campgrounds and road turn-outs between 1,000 and 5,000 feet along Highway 180 and Highway 190. None of 30 *I. pacificus* ticks collected was infected with *B. burgdorferi*. However, ticks infected with *B. burgdorferi* infected ticks were collected from Sequoia NP (which is surrounded by Sequoia NF) during 2000.
- Additionally, 38 *D. occidentalis* and two *D. variabilis* were collected from the USFS sites.
- Evaluated hantavirus risk at Peppermint Fire Camp, Needles Lookout, and Mule Creek Lookout. Hantavirus risk at Peppermint Fire Camp was moderate with storage areas being of greatest concern. Risk at Needles Lookout was high due to the use of a basement storage area for sleeping during severe storms and the presence of rodent excreta in this area. Risk of hantavirus transmission at Mule Creek appeared low. Risk reduction methods were discussed with USFS fire personnel at these sites.
- Investigated human plague case on private land just south of Sequoia NF near the town of Lorraine. Ground squirrel deaths were evident (presumably from plague). Ground squirrels were trapped and one of three ground squirrels tested was infected with plague bacteria. Flea

pools were collected from rodent burrows at a nearby site where ground squirrel deaths were also noted, however plague bacteria were not isolated from any of the flea pools.

- Conducted plague surveillance at Boulder Gulch, Pioneer Point, and Paradise Cove campgrounds. Ground squirrel numbers were high at each of these campgrounds. None of 28 ground squirrels tested were infected with plague bacteria. The remaining campgrounds around Lake Isabella (Main Dam, French Gulch, Hungry Gulch, Tillie Creek, Live Oak, Sandy Flat, and Hobo) were visually surveyed but rodent populations were not substantial and plague risk appeared low.
- Conducted plague surveillance at Alder Creek campground. None of six ground squirrels captured and tested for plague was infected. Plague caution signs were posted due to the presence of a moderate ground squirrel population.
- Visually surveyed campgrounds in Hume Lake Ranger District for rodent activity and plague risk. Survey included Hume Lake, Landslide, Princess, and Tenmile campgrounds. Rodent activity was moderate at Hume Lake campground and plague epidemiology was discussed with USFS personnel at this site. Rodent activity appeared low at the remaining campgrounds. Vector-borne disease epidemiology was discussed with USFS personnel at the district office, and literature and caution signs were provided for posting.
- Visually surveyed campgrounds in the Tule River Ranger District for rodent activity and plague risk. Plague risk appeared low at all campgrounds (Quaking Aspen, Peppermint, Long Meadow, Redwood Meadow, Holey Meadow, Limestone, Fairview, Gold Ledge, and Hospital Flat). Vector-borne disease epidemiology and risks were discussed with campground hosts. Educational literature on the epidemiology of vector-borne diseases was provided for posting at the campgrounds.
- Evaluated the risk for vector-borne disease transmission to USFS fire personnel at Kennedy Meadows Fire Camp (Mentor Fire Camp). Risk of disease transmission appeared low. Provided written report outlining suggestions for improving the camp design to reduce disease transmission risk.
- Discussed plague and hantavirus epidemiology with USFS personnel at Hot Springs Ranger District. Provided educational literature on vector-borne disease epidemiology for dissemination to campground hosts in the district.

Shasta-Trinity National Forest

- Sampled ticks at four campgrounds along the McCloud River in the McCloud Ranger District. This survey was part of an ongoing *Ixodes* surveillance program in the northern forests. Few *I. pacificus* were collected indicating a low risk for transmission of Lyme disease at these campgrounds.
- Conducted hantavirus risk assessment at Little Mt. Hoffman Fire Lookout. This fire lookout is available for rent by the public. The majority of the lookout was appropriately rodent-proofed, and the area of greatest risk appeared to be the latrine. Assessment findings were discussed with USFS personnel at McCloud Ranger District.
- Inspected Coffee Creek and Mule Creek Fire Stations for rodent activity. Focused inspections on workshops, storage areas, and living spaces. Discussed hantavirus epidemiology and risk factors with fire captains. Provided suggestions on rodent proofing and food storage.

Sierra National Forest

- Visually surveyed Camp Edison campground for rodent activity to evaluate plague risk. Risk of plague transmission at this site was considered low.
- Discussed vector-borne disease epidemiology and risk factors with USFS biologists and personnel at Pine Ridge Ranger Station. Provided educational literature to USFS personnel.
- Discussed vector-borne disease epidemiology and risk factors with USFS personnel at Headquarters Ranger Station. Provided educational literature to USFS personnel.

Six Rivers National Forest

- Conducted Lyme Disease risk assessments at Patrick Creek, Grassy Flat, Panther Flat, and Big Flat campgrounds along the Smith River. One of 23 *I. pacificus* ticks collected from Big Flat campground was infected with *B. burgdorferi*. Six *I. pacificus* were collected from the remaining three campgrounds. Risk assessments were discussed with USFS personnel from Gasquet Ranger District as well as the Del Norte County Departments of Public Health and Environmental Health. Follow-up surveillance included collection of 19 *I. pacificus* and no ticks, none of which were infected with *B. burgdorferi*. It was noted that adult tick densities diminished within the Smith River drainage as a function of distance from the coast.

Stanislaus National Forest

- Conducted visual surveillance for plague at Big Meadows Campground, Big Meadows Picnic Area and Group Campground, Cottage Spring Picnic Area, and Ganns Meadow Trailhead. Contacted USFS personnel at Dorrington and Calaveras Ranger Stations to discuss plague and hantavirus risk and to provide educational literature on these diseases. Also met with the USFS Community Planner at Calaveras Ranger Station to discuss vector-borne disease issues.
- Surveyed and evaluated Baker, Brightman Flat, Cascade Creek, Clark Fork, Dardenelle, Deadman, Douglas Picnic, Eureka Valley, Fence Creek, Fraser Flat, Hermit Valley, Lake Alpine, Mill Creek, Niagra Creek, Pacific Valley Pigeon Flat, Sand Flat, Silver Tip, Spicer, and Stanislaus River campgrounds for plague risk. Plague caution signs were posted and disease epidemiology and risk reduction discussed with USFS personnel and concessionaires.

Tahoe National Forest

- Inspected campgrounds at Cottonwood Spring, Upper and Lower Little Truckee River, Prosser Reservoir, and Stampede Reservoir for rodent activity. Ground squirrel populations were moderate to high and plague risk was considered high due to the historical presence of plague in this area. Plague warning signs were posted at all sites. Contacted Sierraville and Truckee Ranger Districts as well as California Land Management concessionaires to discuss plague prevention and risk reduction.
- Conducted visual plague surveillance at Boca, Boca Rest, Boyington Mill, Goose Meadows, Granite Flat, Prosser, Silver Creek, Annie McCloud, Lakeside, and North Fork campgrounds. Ground squirrel populations were moderate to high and plague risk was considered high due

to history of plague in this area. Campgrounds were posted with plague signs and educational literature was provided to campground hosts and USFS personnel.

- Evaluated plague risk at Lodgepole, Indian Springs, Woodchuck, and Hampshire Rocks campgrounds. Plague risk evaluations were also conducted at Donners Pass Reserve, Lake Spaulding, and the Assembly of God property at Eagle Mountain. Ranger district representatives and concessionaires were briefed on risk factors and plague caution signs were posted.
- Evaluated plague risk at Bowman Lake, Lindsey Lake, Jackson Creek, East Meadow, Findley, Fir Top, Pass Creek, and Woodcamp campgrounds. Ranger district representatives and concessionaires were briefed on risk factors and plague caution signs were posted.
- Surveyed campgrounds in the Sierra Buttes region for rodent activity. Sites surveyed included Berger Creek, Diablo, Sardine Lake, Salmon Lake, Packsaddle, Goose Meadows, Granite Flat, Silver Creek, and Logger campgrounds. Risk was considered low-to-moderate at all sites. All sites were posted with plague warning signs.
- Discussed plague and hantavirus epidemiology and risk with the camp director of the Camp Wa Sue II Girl Scouts of America camp located within USFS lands. Provided the camp director with literature and signs for posting.

OTHER SERVICES PROVIDED:

- Assisted in the development of an immunoflourescent assay test to detect the presence of Lyme disease spirochetes (*B. burgdorferi*) in ticks.
- Compiled data on tick surveillance conducted on USFS lands from 1980 to the present. This data will provide historical information on species presence and infection rates of ticks throughout the NF system in California.
- Developed a presentation on the identification of rodents of public health importance. This presentation uses Microsoft® PowerPoint® slides and preserved rodent skins to assist public health workers in recognizing and identifying rodent hosts of plague, hantavirus, arenavirus, and Lyme disease.
- Collaborated with USFS biologists throughout California to identify sites of concentrated woodrat nests. Woodrats are thought to be a primary reservoir of the arenavirus Whitewater Arroyo in California. This work was conducted in response to the identification of arenavirus infection in two Californians who died during 2000. These are the first known human cases of disease associated with this virus in the United States.
- Conducted a plague control project at the US Army Corps of Engineers Martis Creek campground near Truckee (adjacent to USFS lands). Project evaluated the effectiveness of liquid insecticide treated bait tubes as compared to traditional insecticide dusting of rodent burrows for flea control. Both methods appeared to give similar control of fleas. However, bait tubes required significantly less insecticide per unit of coverage area. This method of flea control will be further evaluated as an alternative for use at USFS campgrounds.
- Worked with the FDA and a private manufacturer to get FDA approval of lufenuron (an insect growth regulator) formulated into bait cubes for use in flea control on wild rodents. Insecticide treated bait cubes may serve as an effective way for USFS campgrounds and other human use areas to be treated during active-use seasons to reduce flea loads on wild rodents. The reduction in flea loads on wild rodents would reduce the risk of plague transmission to humans at these sites.

- Initiated the conversion of the VBDS historical plague database into Microsoft® Access® format. This database contains records dating back to 1909 of animals infected with plague. The database includes records from 48 California counties. This database conversion will assist VBDS biologists and others interested in plague control and plague research to access historical records. A by-Forest listing of animals infected with plague was provided to each DHS Public Health Biologist and to the USFS liaison to VBDS.
- Developed fact-sheets on tick-borne, rodent-borne, and insect-borne diseases. Fact sheets were also developed for insects of public health importance (Africanized honeybee and red imported fire ant).
- Provided training in vector-borne disease epidemiology and vector control to USFS personnel, county environmental health departments, and vector control districts that work on USFS lands. Training was provided through annual workshops, special seminars and presentations, and field demonstrations.

Report prepared by Alec Gerry and Vicki Kramer

Caltrans Project: Vector Production

In 1999, the Vector-Borne Disease Section (VBDS) entered into a contractual agreement with the California Department of Transportation (Caltrans) to provide technical expertise on vectors and vector-borne diseases relative to the Caltrans Stormwater Best Management Practice (BMP) Retrofit Pilot Study. The purpose of the Caltrans study was to evaluate the efficacy of various structural designs toward improving the quality of stormwater runoff from freeways, park-and-rides, and maintenance stations prior to its discharge into natural waterways. There was concern that these stormwater treatment facilities potentially increased available habitat for aquatic stages of arthropod disease vectors, and created harborage, food, and moisture for reservoir and nuisance species. The agreement required VBDS to establish a comprehensive vector surveillance and monitoring program, provide vector abatement protocols, and recommend appropriate engineering modifications that would reduce the potential for these BMPs to produce or harbor vectors which are deleterious to public health. In addition to reviewing the BMP design and operations data, VBDS was charged to determine which BMP designs were least conducive to vector production. VBDS will continue to monitor the public health impacts of this project through June 2003.

In accordance with the agreement, VBDS established comprehensive vector surveillance and monitoring plans for 30 BMP Pilot Project study sites located in Los Angeles (Caltrans District 7) and San Diego (Caltrans District 11) counties. The plans outlined various activities to be conducted in collaboration with Greater Los Angeles County Vector Control District, San Gabriel Valley Mosquito and Vector Control District, Los Angeles County West Vector Control District, and San Diego County Vector Control Program. The primary task of the local vector control agencies was to monitor all BMP Pilot Project study sites each week for immature stages of mosquitoes, midges, and sand flies. VBDS staff maintained an independent surveillance schedule to monitor vegetative cover, predators of immature mosquitoes, physical and chemical properties of water, and evidence of rodent and other vector populations. VBDS recommended to all collaborating vector control agencies a single vector abatement regimen. A liquid formulation of the insect growth regulator methoprene (Altosid™, a juvenile hormone mimic that inhibits successful emergence of adult mosquitoes and a variety of midges) was selected because of its short residual activity and negligible effects on larval population dynamics.

Seven mosquito species have been collected from Caltrans BMPs, five of which are known vectors of human disease. These species include *Culex stigmatosoma*, *Cx. tarsalis*, *Cx. quinquefasciatus*, *Culiseta incidens*, *Cs. inornata*, *Anopheles hermsi*, and *An. franciscanus*. Of the nine different BMP technologies included in the study, surveillance activities determined that several consistently produce mosquitoes in large numbers, particularly Multi-Chambered Treatment Trains (MCTT), Continuous Deflection Separators (CDS), and the wet basin pond. In contrast, biofiltration swales and strips, infiltration trenches, and extended detention basins have produced few or no mosquitoes to date.

VBDS activities conducted in 2000 include the following:

- Conducted weekly (June-October) and bi-weekly (January-May, November-December) data collection and sampling of Caltrans BMPs.

- Continued collaboration with local vector control districts involved with the Caltrans BMP study; provided them with a standardized data collection form.
- Maintained and regularly updated a computer database designed to collate and archive water quality data, collected by VBDS, and mosquito sampling data, collected by collaborating vector control districts.
- Provided written recommendations to Caltrans on BMP modifications necessary to reduce or eliminate vector production and to facilitate access for vector control personnel for routine surveillance and abatement.
- Presented study data and information on stormwater BMPs and associated vectors at professional meetings and continuing education sessions.
- Drafted an interim report on vector production associated with the Caltrans BMP sites based on data provided by collaborating vector control agencies and compiled by VBDS.
- Completed a nationwide study to address stormwater BMPs and vector production. A summary of the survey is provided below.

Nationwide Survey

Little information is available on vector problems associated with BMP or BMP-like structures. Therefore, VBDS prepared a detailed questionnaire to survey vector control agencies nationwide on vector problems and solutions associated with different stormwater management structures. In January 2000, 298 questionnaires were mailed to selected agencies across the United States. Of these, 85 were sent to agencies within the state of California and 203 were sent out-of-state. One hundred five agencies (35%) returned the questionnaire, and 72 of these agencies (69%) provided information on mosquitoes and other vectors associated with local BMPs. Agencies from 25 states participated in the survey, representing regions with dramatically different climates, ecosystems, and human population density.

Participating vector control agencies listed a wide variety of stormwater management structures with which they were familiar. Thirty-three of 38 out-of-state (86%) and 29 of 34 in California (85%) reported mosquito production in these structures. Agencies reported several factors that contributed to mosquito production, including design flaws, slow drain-down, and irregular (or complete lack of) maintenance that resulted in poorly functioning structures. In general, structures subjected to environmental damage and clogging resulted in standing water and associated vector production. The accumulation of vegetation, silt, and debris in stormwater BMPs indicated the need for ongoing maintenance to prevent the occurrence of standing water.

A number of mosquito species reportedly breed in stormwater management structures in the United States. Mosquitoes in the genus *Culex* were reported most commonly (63 of 72 agencies), both in the state of California and elsewhere (Fig. 7). Other species reported to use these structures included mosquitoes in the genera *Aedes* (28 agencies), *Anopheles* (20), *Culiseta* (13), *Psorophora* (4), *Coquillettidia* (4), and *Mansonia* (2). Chironomid midges were reported to be a significant problem in stormwater BMPs, second only to mosquitoes. These insects were most frequently associated with large retention ponds and lakes. Rodents and black flies were also frequently reported to be in and around structures.

The information obtained from this survey supports VBDS data regarding the potential public health risks associated with the construction of stormwater management structures. Responses to the questionnaire provide evidence that these structures may create suitable habitats for disease

vectors unless preventive design and subsequent maintenance practices remain a priority. This survey also demonstrated the need for collaboration between water quality and vector control agencies. Information from the nationwide survey and the Caltrans BMP Retrofit Pilot Study will aid in future design and construction of methods employed for management of stormwater runoff Caltrans BMPs ultimately will constitute less than 2% of the total number of structures that will be built throughout California to comply with requirements of the federal Clean Water Act and resulting National Pollution Discharge Elimination System (NPDES) permit, as well as other state requirements. It is critical that as these structures are built to improve the quality of stormwater runoff, public health hazards are not created.

Report prepared by Marco Metzger, Chuck Myers, and Vicki Kramer

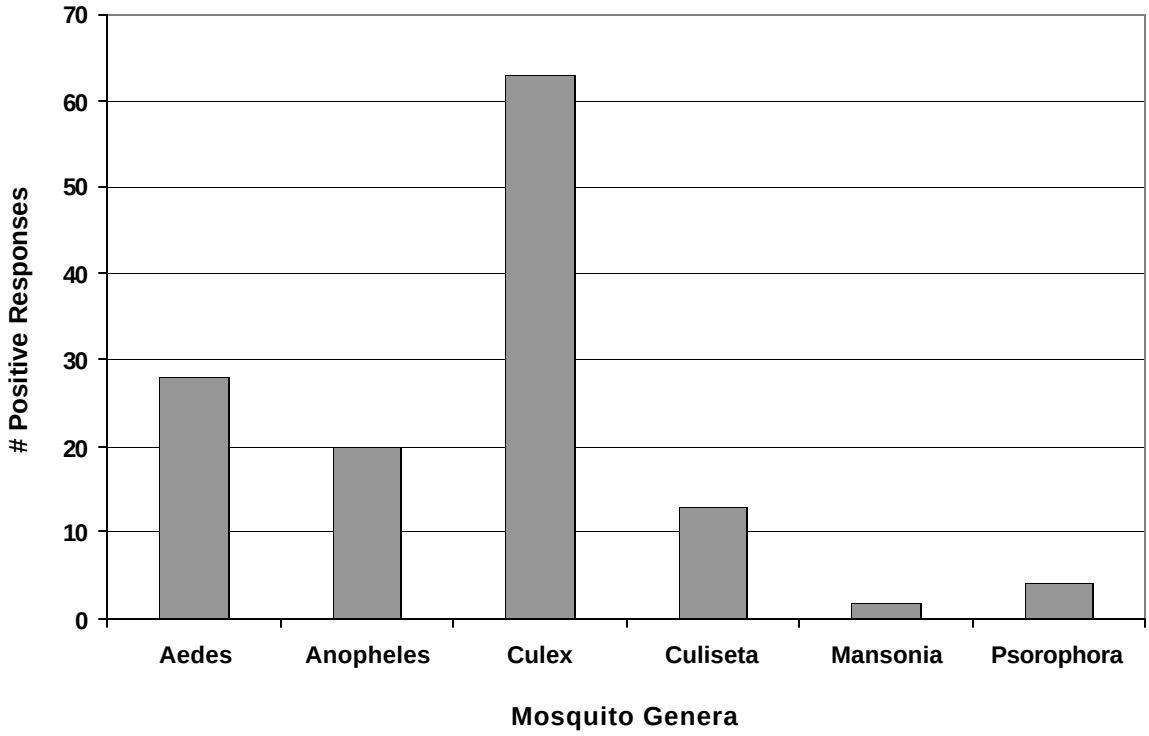

Figure 7. Mosquito Genera Utilizing Stormwater Management Devices in the United States

Source: California Department of Health Services

Vector Control Technician Certification Program

The California Department of Health Services (DHS) administers the Public Health Vector Control Technician certification examination in May and November each year. The purpose of this examination is to certify the competence of government agency personnel in the control of vectors for the health and safety of the public. Authority to administer this exam issues from Health and Safety Code, Section 106925, which requires every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes to be certified by DHS. Standards governing certification of local agency vector control personnel are found in Title 17 of the California Code of Regulations, Sections 30001-30061. The first DHS-sponsored certification examination to qualify agency personnel in mosquito control was held in April 1974.

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. The Core section consists of questions on the safe and effective use of pesticides. Specialty sections contain questions on the control of relevant vectors of the other exam sections listed in Table 13. Successful examinees are issued a gold certification card, which is valid for two years in the qualified categories specified on the card. To maintain their full certification status, certified technicians are required to pay annual renewal fees and meet minimum continuing education requirements in each two-year cycle. Successful examinees who elect not participate in continuing education are issued parchment certificates in the categories in which they qualified. These certified technicians (limited) employees may not use pesticides except under the direct supervision of a certified technician.

At year's end, 1044 vector control technicians employed at 100 local public health agencies held 2328 certificates (Table 14). The local agencies include 51 mosquito abatement districts, mosquito and/or vector control districts and other special districts, 35 departments of county government, 13 departments of city government, and the Vector-Borne Disease Section of DHS.

Report prepared by Malcolm Thompson

Table 13. Results of certification examinations administered in 2000.

Exam Section	No. Exams Given	No. Passed (%)
Core	144	104 (72.2%)
Mosquito Control	139	87 (62.6)
Terrestrial Invertebrate Vector Control	142	78 (54.9)
Vertebrate Vector Control	116	100 (86.2)
TOTAL	541	369 (68.2)

Table 14. Vector Control Technician certificates in effect as of December 2000.

	No. Certificates		
Certification Category	**Full Status**	**Limited Status**	**Sum**
Mosquito Control	639	175	814
Terrestrial Invertebrate Vector Control	515	195	710
Vertebrate Vector Control	533	271	804
TOTAL		2328	

Source: California Department of Health Services

Head Lice Prevention and Control Program

The Vector-Borne Disease Section (VBDS) conducted numerous activities in 2000 to educate the medical community, school officials, and the public about head lice prevention and control. In January, California Department of Health Services (DHS) published an article entitled "California Program to Prevent and Control Head Lice" in the California Medical Board Action Report. The article provided recommendations on treatment of head lice to the approximately 100,000 licensed physicians who receive the newsletter. DHS received numerous inquiries from physicians following publication of the article.

Two documents were distributed to local health departments in June: "Guidelines for School Districts and Child Care Facilities on Head Lice" and "Guidelines for Parents on Control of Head Lice". Condensed versions of these guidelines were included in the annual August mailing from the DHS Immunization Branch to most of the schools in California with kindergarten enrollment.

DHS issued a news release in October on head lice that summarized the guidelines for the public. These guidelines for parents were also highlighted on the DHS web page (www.dhs.ca.gov) for several weeks. DHS consulted with 26 local health departments, CDC, university researchers, several lice control product companies, the National Pediculosis Association, and many physicians on head lice issues throughout the year. Presentations were given to the public health and school nurses, mosquito and vector control districts, and the DHS and Department of Education Workgroup on Interagency School Health.

Availability of effective head lice treatments continued to be a major concern in 2000. However, Ovide®, a 0.5% malathion formulation, was added to the Medi-Cal Formulary as a head lice treatment in 2000. This was an extremely important step initiated by DHS to provide Medi-Cal eligible patients an effective pediculicide alternative to permethrin and pyrethrins for the first time in over 14 years. In September 2000, Governor Davis signed legislation, effective January 2002, that prohibits use of lindane products (e.g Kwell®) for control of head lice and scabies. Finally, DHS initiated a cooperative multi-year study with CDC on head lice resistance in California. CDC tested lice from several areas in Butte County with preliminary findings that indicated no resistance to permethrin.

DHS initiated a study to gain information on the number of head lice cases and days missed from school in one rural and one urban county. The data indicated that long-term school absences due to head lice occurred predominantly among children from disadvantaged families. Failure to treat these children kept them out of school for extended periods. DHS will continue to explore this problem of long-term absences associated with head lice in 2001.

Report prepared by Stan Husted

Presentations and Publications

Presentations

JANUARY

- **Biological Control of Ixodid Ticks using Wasp Parasitoids**
  Mosquito and Vector Control Association of California (MVCAC) Annual Conference, Sacramento: Renjie Hu
- ***Borrelia burgdorferi* Vaccine: A Shot in the Arm for Lyme Disease?**
  MVCAC Annual Conference, Sacramento: Curtis Fritz
- **Personal Experience of a Public Health Biologist in Dealing with the Complexity of Lyme Disease in California**
  MVCAC Annual Conference, Sacramento: Lucia Hui
- **Impact of Climatic Extremes on Vector-Borne Diseases in California**
  MVCAC Annual Conference, Sacramento: Richard Davis
- **Roles and Responsibilities of Public Agencies in Emergency Situations**
  MVCAC Annual Conference, Sacramento: Vicki Kramer
- **Vector-borne Diseases in California and the United States: 1999 Update**
  MVCAC Annual Conference, Sacramento: Vicki Kramer
- **Surveillance for Mosquito-Borne Encephalitis Virus Activity and Human Cases in California, 2000**
  MVCAC Annual Conference, Sacramento: Stan Husted
- **Use of Liquid Deltamethrin in Modified, Host-Targeted Bait Tubes for Control of Fleas on Sciurid Rodents in Northern California**
  MVCAC Annual Conference, Sacramento: Lawrence Bronson and Charles Smith
- **California Program for Head Lice Prevention and Control**
  Butte County Public Health and School Nurses Continuing Education Workshop and MVCAC Sacramento Valley Region Continuing Education Workshop, Oroville: Stan Husted
- **Working with FEMA following a Disaster in California**
  State Public Health Vector Control Conference, Ft. Collins, Colorado: Vicki Kramer

FEBRUARY

- **Africanized Honey Bees**
  MVCAC Coastal Region Continuing Education Workshop, San Ramon: Todd Walker
- **Coldfogging Techniques Using Aqua-Reslin**
  MVCAC Sacramento Valley Region Continuing Education Workshop, Sacramento: Ken Townzen
- **Hantavirus Field Safety Protocols**
  American Biosafety Association, La Jolla: Richard Davis
- **The Black Death: A Danse Macabre with Plague through the Ages**
  Biology Club Alumni Lectures, Whittier College, Whittier: Curtis Fritz
- **Vector-borne Diseases in California: 1999 Update**
  State Public Health Vector Control Conference, Ft. Collins, Colorado: Vicki Kramer

MARCH

- ***Baylisascaris* Larval Migrans in California**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Curtis Fritz
- **Hantavirus in California**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Curtis Fritz
- **Epidemiology of Seoul Virus**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Alec Gerry
- **Murine Typhus**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Todd Walker
- **Control of Rodent-Borne Diseases**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Ken Townzen
- **Surveillance of Rodent-Borne Diseases**
  DHS/MVCAC Vertebrate-Borne Disease Workshop, Santa Fe Springs and Vacaville: Richard Davis
- **Plague and Hantavirus in Northern California Counties**
  Shasta County Public Health and Environmental Health Departments, Redding: Charles Smith
- **Plague, Hantavirus, and other Rodent-Borne Diseases**
  Diseases of California Wildlife Workshop, Western Section of the Wildlife Society, Davis: Curtis Fritz
- **Potential Hantavirus and Tick-Borne Relapsing Fever Exposures in USFS Facilities**
  Plumas National Forest, Fire Management Meeting: Lawrence Bronson
- **Protecting Yourself from Rodent-Borne Diseases**
  19th Annual Vertebrate Pest Conference, San Diego: Ken Townzen
- **Ticks and Tick-Borne Diseases of the Central Coast**
  Sierra Club, San Luis Obispo; Girl Scouts, Goleta; Diablo Canyon docents, San Luis Obispo: Richard Davis

APRIL

- **California Head Lice Prevention and Control Program**
  MVCAC Sacramento Valley Region Continuing Education Workshop, Sacramento: Stan Husted
- **Dengue Virus: A Concern for Californians?**
  California Environmental Health Association Annual Conference, Fresno: Alec Gerry
- **Hantavirus Pulmonary Syndrome**
  Epidemiology & Control of Infectious Diseases (PH 253B), School of Public Health, University of California, Berkeley: Curtis Fritz
- **Lyme Disease in California Update**
  Bay Area Lyme Disease Support Group Quarterly Meeting, Albany: Lucia Hui
- **Providing Secure Funding for Vector Control Programs**
  Washoe County Board of Health, Reno, Nevada: Ken Townzen

- **Rodent-Borne Diseases in Northern California**
  Shasta Mosquito and Vector Control District Continuing Education Workshop, Redding: Charles Smith
- **Tales of an Itinerant Epidemiologist**
  Veterinary Epidemiology (VMD 409), School of Veterinary Medicine, University of California, Davis: Curtis Fritz
- **The Black Death: A Danse Macabre with Plague through the Ages**
  Epidemiology & Control of Infectious Diseases (PH 253B), School of Public Health, University of California, Berkeley: Curtis Fritz
- **Those Icky Ticks: Review of Tick-transmitted Infectious Diseases in California**
  Amador County Continuing Medical Education Workshop, Jackson: Curtis Fritz
- **The Complexity of Lyme Disease in California**
  California Environmental Health Specialist Annual Conference, Fresno: Lucia Hui

MAY

- **Emergency Arbovirus Response Plan**
  West Nile Virus Workshop, Sacramento: Vicki Kramer
- **Hantavirus: Awareness and Precautions to PG&E Workers**
  PG&E, Daly City: Al Hom
- **Hantavirus Overview**
  Rutherford & Chekene Consulting Engineers, San Francisco: Al Hom
- **Tick-Borne Diseases and Hantavirus**
  Golden Gate National Recreation Area, Marin Headlands: Marty Castro
- **Ticks and Tick-Borne Diseases of the Central Coast**
  Animal Science Zoonosis class, Cal Poly State University, San Luis Obispo: Richard Davis

JUNE

- **Applications and Case Studies in Forensic Entomology**
  Medical Entomology Graduate Seminar, University of California, Berkeley: Al Hom
- **Hantavirus: Precautions and Methods for Clean-Up**
  Pest Control Operators, Pasadena: Richard Davis
- **Vectorial Capacity of *Culicoides sonorensis* for the Transmission of Bluetongue Virus in Southern California**
  Pacific Branch Annual Meeting of the Entomological Society of America, Costa Mesa: Alec Gerry

JULY

- **Arenaviruses**
  Northern Inyo Medical Group, Bishop: Curtis Fritz
- **California Department of Health Services Activities on USFS Land**
  US Forest Service District Fire Management Officers Annual Meeting, Sacramento: Alec Gerry
- **Forensic Entomology Overview**
  Bay Region Vector Disease Group, Alameda: Al Hom

- **Hantavirus Pulmonary Syndrome in California**
  Clark Pest Control, Sacramento: Jim Tucker
- **Hantavirus Update**
  Northern Inyo Hospital, Bishop: Curtis Fritz

AUGUST

- **Hantavirus and Plague in California**
  USDA Wildlife Service, Fish Camp: Jim Tucker
- **Tick, Plague, and Hantavirus Safety**
  Vandenberg Air Force Base, Vandenberg: Richard Davis

SEPTEMBER

- **Caltrans BMP Retrofit Pilot Studies: A Preliminary Assessment of Vector Production**
  Caltrans Storm Water Quality Workshop, Los Angeles: Vicki Kramer
- **Coldfogging: Droplets, Aerosol, and Weather**
  MVCAC San Joaquin Region Continuing Education Workshop, Stockton: Ken Townzen
- **Hantavirus and Arenavirus in California**
  PG&E Monthly Safety Meeting, San Francisco: Lucia Hui
- **Lyme Disease: Are You at Risk?**
  15th National Trails Symposium, Redding: Jim Tucker
- **Tick and Hantavirus Safety**
  Southern California Gas Company Safety Workshop, San Luis Obispo: Richard Davis

OCTOBER

- **Bloodborne Babesiosis in a Baby Boy from the Bay Area**
  West Coast Epidemiologists Conference, Yreka: Curtis Fritz
- **Ehrlichiosis**
  Southern Humboldt Community Hospital, Garberville: Curtis Fritz
- **Epidemiology and Ecology of Hantaviruses in California**
  Society for Vector Ecology Annual Conference, Berkeley: Curtis Fritz
- **Vector-Borne Diseases in California: An Update**
  Society for Vector Ecology Annual Conference, Berkeley: Vicki Kramer
- **Ecology of Lyme Disease in California**
  Tick-Borne Disease Seminar, Nevada City: Lucia Hui
- **Ecology of the Lyme Disease Spirochetes**
  Sierra Nevada Memorial Hospital Continuing Education Workshop, Grass Valley: Lucia Hui
- **Lyme Disease in California**
  Pacific Bell Safety Officers' Monthly Meeting, Santa Cruz: Lucia Hui
- **Status of Exotic Pests in California: Africanized Honey Bees and Red Imported Fire Ants**
  California Environmental Health Association, Northern California Educational Update and Redwood Chapter Training, Santa Rosa: Todd Walker
- **The DHS Head Lice Program Recommendations for Schools**
  Workgroup on Interagency School Health, Sacramento: Stan Husted

NOVEMBER

- **California Department of Health Services Activities on USFS Land**
  USFS Supervisors Training Session, Sonora: Mark Novak
- **Epidemiology of Rodent-Borne Viruses**
  MVCAC South San Joaquin Valley Continuing Education Workshop, Visalia: Alec Gerry
- **How to Conduct a Plague Surveillance Program**
  MVCAC Coastal Region Continuing Education Workshop, San Ramon: Charles Smith
- **Medical Entomology in the U.S. Navy**
  MVCAC Northern San Joaquin Valley Region Continuing Education Workshop, Stockton: Mark Novak
- **Rodent Taxonomy**
  MVCAC South San Joaquin Region Continuing Education Workshop,Visalia: Jim Tucker
- **Ticks of Public Health Importance**
  MVCAC South San Joaquin Region Continuing Education Workshop, Visalia: Jim Tucker
- **Hantavirus Pulmonary Syndrome in California**
  Roseville Pest Control, Roseville: Jim Tucker
- **Lyme Disease in California and a Personal Account of this Disease**
  Lyme Disease Resource Center Annual Conference, San Francisco: Lucia Hui
- **Rodents and Rodent-Transmitted Disease Prevention**
  PAPA Workshop, Oxnard: Richard Davis
- **Update on Vector-borne Diseases in California and Review of VBDS Activities in 2000**
  Santa Clara County Annual Environmental Health Department Staff Meeting, Campbell: Stan Husted
- **West Nile Virus and Eastern Equine Encephalomyelitis**
  Bay Area Vector-Borne Disease Group, Alameda: Stan Husted

Publications (VBDS authors in **bold**)

Durden LA, **Hu R**, Oliver JH, Cilek JE. Rodent ectoparasites from two locations in Northwestern Florida. *Journal of Vector Ecology* 2000; 25:222-8.

Gage KL, Dennis DT, Orloski KA, Ettestad P, Brown TL, Reynolds PJ, Pape WJ, **Fritz CL**, Carter LG, Stein JD. Cases of cat-associated human plague in the western United States (1977-1998). *Clinical Infectious Diseases* 2000; 30:893-900.

Gerry AC, Mullens BA. Seasonal abundance and survivorship of *Culicoides sonorensis* (Diptera: Ceratopogonidae) at a southern California dairy, with reference to potential bluetongue virus transmission and persistence. *Journal of Medical Entomology* 2000; 37:675-88.

Hu R, Durden LA, Oliver JH. Winter ectoparasites of mammals in the northeastern Piedmont area of Georgia. *Journal of Vector Ecology* 2000; 25:23-7.

Hu R, Rowley WA. Relationship between blood intake of the nymphal stage and resultant sexes in *Ixodes scapularis* and *Dermacentor variabilis* ticks (Acari: Ixodidae). *Journal of Medical Entomology* 2000; 37:198-200.

Husted S. California program to prevent and control head lice. *Medical Board of California Action Report* 2000; 72(January):5.

Husted S, **Kramer VL**, Ascher MS, Rogers C, Reisen WK, Eldridge BF, Chiles R, Eliason DA. Surveillance for mosquito-borne encephalitis virus activity and human disease in California, 2000. *Proceedings of the Mosquito and Vector Control Association of California* 2000; 68:32-6.

Hyland KE, Bernier J, Markowski D, MacLachlan A, Amr Z, Pitocchelli J, Myers J, **Hu R.** Records of ticks (Acari: Ixodidae) parasitizing birds (Aves) in Rhode Island, USA. *International Journal of Acarology* 2000; 26:183-92.

Kramer VL. Roles and responsibilities of public agencies in emergency situations. *Proceedings of the Mosquito and Vector Control Association of California* 2000; 68:13-4.

Mullens BA, Velton RK, **Gerry AC**, Braverman Y, Endirs RG. Feeding and survival of *Culicoides sonorensis* on cattle treated with permethrin or pirimiphos-methyl. *Medical and Veterinary Entomology* 2000; 14:313-20.

Pusterla N, Chang C, Chomel B, Chae J, Foley J, DeRock E, **Kramer V**, Lutz H, Madigan J. Serologic and molecular evidence of *Ehrlichia* spp. in coyotes in California. *Journal of Wildlife Diseases* 2000; 36:494-9.

Wright SA, **Thompson MA,** Miller MJ, Knerl KM, Elms SL, Karpowicz JC, Young JF, **Kramer VL**. Ecology of *Borrelia burgdorferi* in ticks (Acari: Ixodidae), rodents, and birds in the Sierra Nevada foothills, Placer County, California. *Journal of Medical Entomology* 2000; 37:909-18.

Young JC, Hansen GR, Graves TK, Deasy MP, Humphreys JG, **Fritz CL,** Gorham KL, Khan AS, Ksiazek TG, Metzger KB, Peters CJ. The incubation period of hantavirus pulmonary syndrome. *American Journal of Tropical Medicine and Hygiene* 2000; 62:714-7.

Acknowledgments

Rodent-borne disease surveillance
Centers for Disease Control and Prevention; TriCore Laboratories; Alameda County Vector Control Service District; Colusa County Environmental Health; Colusa Mosquito Abatement District; Contra Costa Mosquito and Vector Control District; Inyo County Environmental Health; Los Angeles County Department of Health Services; Kern County Environmental Health; Mono County Environmental Health and Health Department; National Park Service; Orange County Vector Control District; Riverside County Environmental Health; Sacramento County Health Department; Sacramento-Yolo Mosquito & Vector Control District; San Bernardino County Vector Control District; San Diego Vector Control Program; Santa Barbara Coastal Vector Control District; Santa Clara County Vector Control District; San Mateo County Mosquito Abatement District; Sutter-Yuba Mosquito & Vector Control District; Tuolumne County Environmental Health; United States Army; United States Forest Service; University of Texas Medical Branch-Galveston;Ventura County Health Department and Environmental Health; Yolo County Health Department and Environmental Health

Tick-borne disease surveillance
Microbial Disease Laboratory Branch and Viral and Rickettsial Disease Branch, California Department of Health Services; Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases; U.S. Army Center for Health Promotion & Preventive Medicine-West; University of California-Berkeley; University of California-Davis; Alameda County Public Health Laboratory; Butte County Mosquito and Vector Control District; Placer County Environmental Health Department; Washoe County (Nevada) Environmental Health

Plague surveillance
Microbial Diseases Laboratory Branch, California Department of Health Services; School of Veterinary Medicine, University of California-Davis; USDA Animal and Plant Health Inspection Service; and participating local mosquito and vector control agencies, health departments, and environmental health departments.

Mosquito-borne encephalitis virus surveillance
Viral and Rickettsial Disease Laboratory Branch, California Department of Health Services; the Center for Vector-borne Disease Research, University of California-Davis; participating local mosquito and vector control agencies; local health departments and physicians and veterinarians.

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